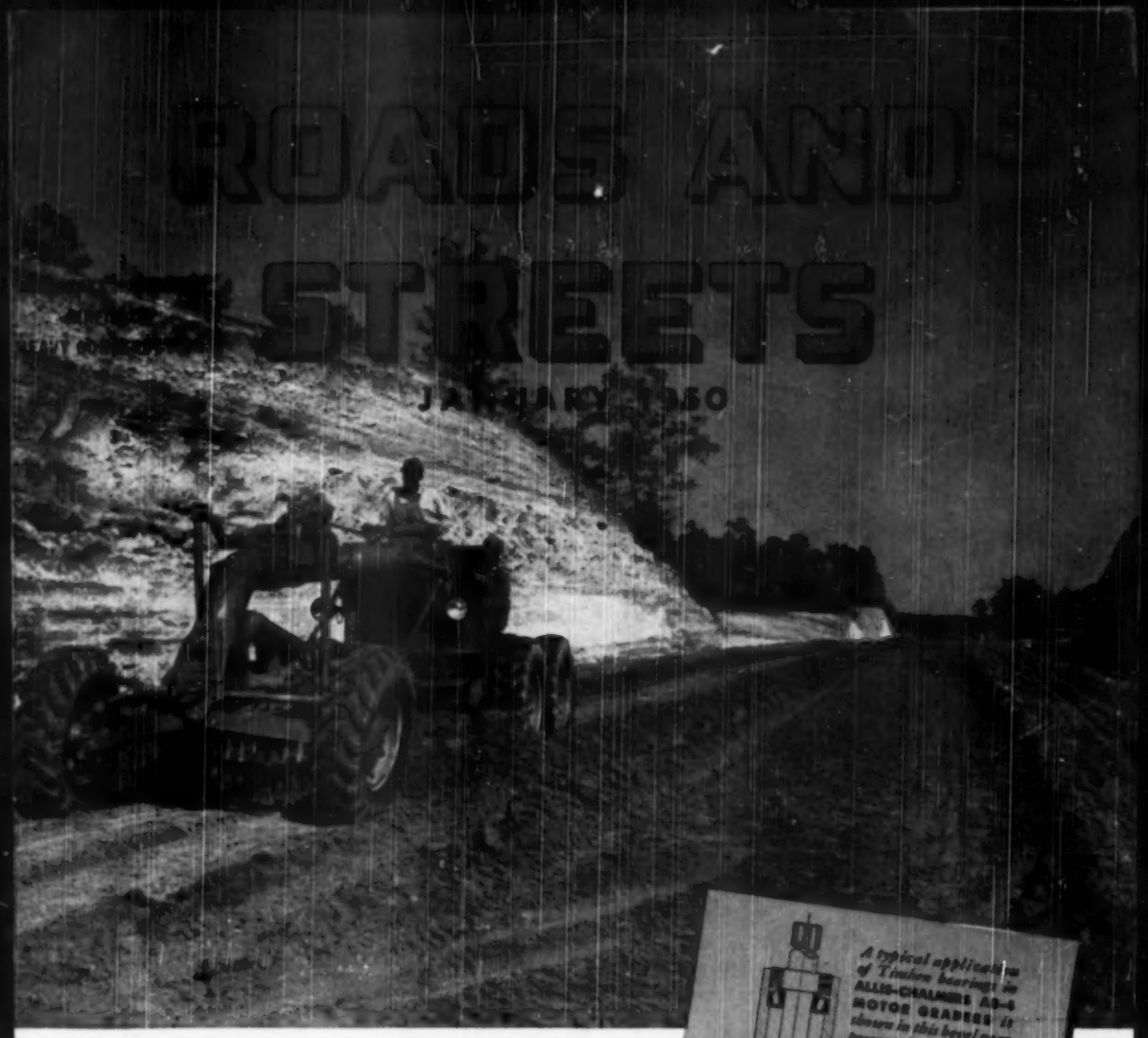
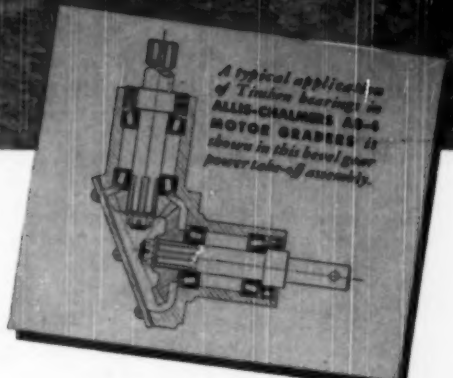



A typical application of Timken bearings in ALLIS-CHALMERS AD-4 MOTOR GRADERS is shown in this bevel gear power take-off assembly.

Grader does a smooth job with 40 TIMKEN® bearings

THIS Allis-Chalmers AD-4 Motor Grader, built for heavy construction duty, assures long, trouble-free performance with 40 Timken® bearings at vital points.

Due to the line contact between the rolls and races, Timken bearings have extra load-carrying capacity. Tapered construction enables them to carry both radial and thrust loads, in any combination. Timken bearings hold gears and shafts in proper alignment, reducing wear and helping to prevent breakdowns.

With Timken bearings road construction equipment stands up longer, requires less maintenance. Look for them in all the machines you buy. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

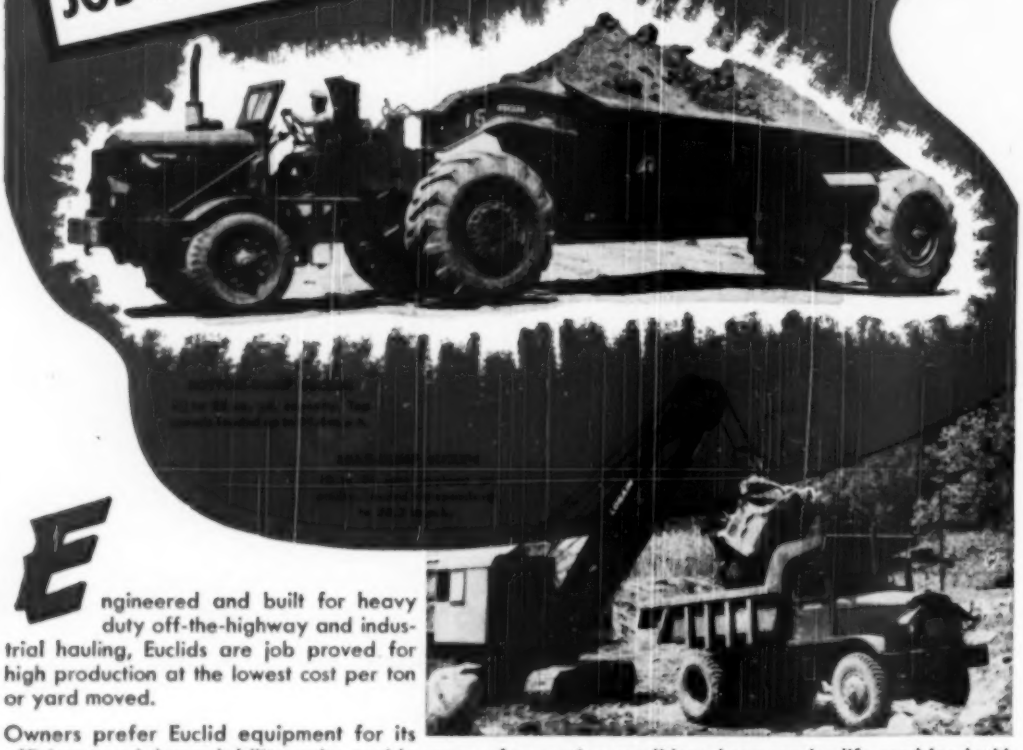
TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

EUCLIDS

JOB PROVED FOR PRODUCTION AND PROFITS!



Engineered and built for heavy duty off-the-highway and industrial hauling, Euclids are job proved for high production at the lowest cost per ton or yard moved.

Owners prefer Euclid equipment for its efficiency and dependability under a wide range of operating conditions. Long service life combined with low operating and maintenance costs result in more profits and less down time. Operators prefer "Eucs" for their ease of handling, riding comfort, and positive control on soft fills and rough haul roads.

"Euclid is the best earth moving equipment we've ever used," say owners . . . "it does more work and costs less to own in the long run." Production records from hundreds of jobs prove that Euclids are the best for performance and profits.

The services of a Euclid specialist are available without cost or obligation. Call or write for an estimate on your present work or future jobs.

The EUCLID ROAD MACHINERY Co. Cleveland 17, Ohio

Left to right: R. S. Over, Dale W. Detwiler and Emmert I. Detwiler, all of New Enterprise Stone and Lime Company, discuss the day's operations.

Rigged with strong wire rope, this powerful shovel swings a big bite of earth toward waiting truck. Old road is shown at right.

Relocating Highway in the Alleghenies

More than five miles of U. S. 220, popular north-south highway traversing mountainous central Pennsylvania, recently underwent repair and relocation between Altoona and Tyrone. Construction of the 3-lane road was handled by New Enterprise Stone and Lime Company, New Enterprise, Pa., and included the erection of four bridges. Bethlehem supplied bridge reinforcing, structural steel, dowel units and cable guard rail.

Bethlehem Reinforcing Bars in place in one of the road's four new bridges. These structures have spans of from 16-ft to 42-ft.

Bethlehem Dowel Unit prior to pouring. Unit can be used for contraction or expansion and holds dowels in near-perfect alignment.

Showing completed highway. Note Bethlehem Cable Guard Rail, mounted on Bethlehem Steel Posts, on both sides of the road.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

STEEL FOR HIGHWAYS

Dowel Units • Reinforcing Bars • Bar Mats • Guard Rail
Guard Rail Posts • Wire Rope and Strand • Pipe
Hollow Drill Steel • Spikes • Bolts and Nuts
Tie-Rods • Timber Bridge Hardware
Sheet- and H-Piling • Fabricated Structural Steel

BETHLEHEM STEEL

ROADS AND STREETS

January, 1950 • Vol. 93 • No. 1

Roads and Streets represents 57 years of continuous publishing in the highway field; combined with Engineering & Contracting and Good Roads Magazines, established in 1892

E. S. GILLETTE, Publisher ECA HALBERT P. GILLETTE, Editor-in-Chief

Coming Articles

Equipment Application
Diesel engines—how much do you know about them? Are you missing any bets in harnessing diesel power? Are you taking proper care of your diesels? An article soon.

Road Maintenance
That most familiar of all machines, the motor grader, is still being poorly or indifferently managed by some highway organizations. Other departments are doing a bang-up job. Case reports coming. How Oregon's ten maintenance crews do their stuff with portable hot-mix plants and patching tools.

Bridges
How a viaduct's deck joints were raised for resurfacing . . . How a southern contractor used a rubber-tired paver to pour footings and piers for overpass . . . An eastern viaduct speeded with help of progressive field methods . . . Australian bridge job, where piers were sunk by open caisson 100 ft. through sand.

Highway Legislation
What did the state legislatures do last year? A nation-wide survey.

Post Road Jobs of 1949
Several case reports from our popular "Knockin' Out the Yardage" Department.

Paving and Surfacing
How a California contractor stepped up his resurface footage with an extra bituminous paver, and saved additional time through small towns by paving urban sections after bedtime . . . Texas experience with blacktopping . . . An airport paving job where the contractor cut dummy joints with a concrete saw.
Ohio's experience with stone base built with vibratory equipment . . . Texas developments in triaxial methods . . . Wisconsin's new approach to roadbed design . . . A wealth of articles coming for "Roads and Streets" readers.

Contractors and the superintendents . . . officials and engineers . . . something for all in each issue of "Roads and Streets". Watch for your next copy. Practical "how it was done" articles invited from readers.

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Col. V. J. Brown, Associate Editor
S. A. Phillips, Field Editor
H. K. Glidden, Contributing Editor
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A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

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B.F.Goodrich

Why you get more recappable tires when you use B. F. Goodrich

IN TOUGH, off-the-road operations like that shown above, mileage doesn't mean much in measuring tire service. Instead, the yardstick is number of hours a tire works and whether or not worn treads can be recapped, or if sharp, jagged rocks cause serious tread cuts.

Reports from B. F. Goodrich users indicate top performance of BFG tires as compared with other brands. For example, one operator reported over 4,500 service hours from B. F. Goodrich *Universals* vs. only 1,600 hours from another make in identical service.

B. F. Goodrich tires stand out in service for many reasons. Tread rubber is specially compounded to resist cutting. More tires can be recapped because they have double bruise protection in the B. F. Goodrich *double nylon shock shield* . . . layers of nylon cord built in between the tread and the body plies.

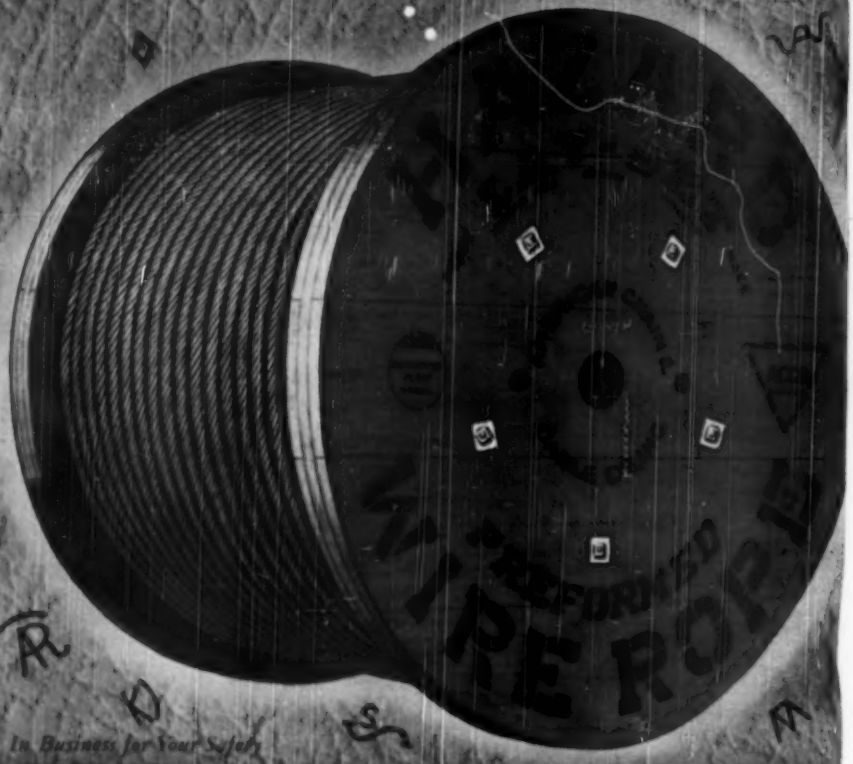
Only BFG gives you the added protection of the nylon shock shield; the added savings of (1) longer tire life (2) increased bruise resistance (3) less danger of tread separation (4) more recappable tires. But nylon shock shield costs no extra — you pay no premium!

Another "special" is the new ALL-NYLON tire for tough construction projects, quarry work, strip mining, etc. In all tests, not a single BFG All-Nylon tire blew out, not one flex break occurred!

There's a specially designed off-the-road type B. F. Goodrich tire for every need. See your dealer or write, wire or phone — *The B.F.Goodrich Company, Akron, Ohio.*

BRANDS are important!

Cattle are branded primarily to prove ownership.
But, experienced cattlemen and livestock buyers know that
some brands are always found on higher quality animals.
These brands come from better feed and water,
from better breeding stock, from better handling.
The HAZARD brand on a reel of wire rope is your assurance of quality—
quality backed by wire rope manufacturing experience
dating back to 1848. Next time specify HAZARD.
Remember—*"Brands are important!"*



ACCO *In Business for Your Safety*

AMERICAN CHAIN & CABLE
HAZARD WIRE ROPE DIVISION

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Amarillo, Texas
8 Northwests

RALPH MILLS
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8 Northwests

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San Francisco, Calif.
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THE DUAL CROWD

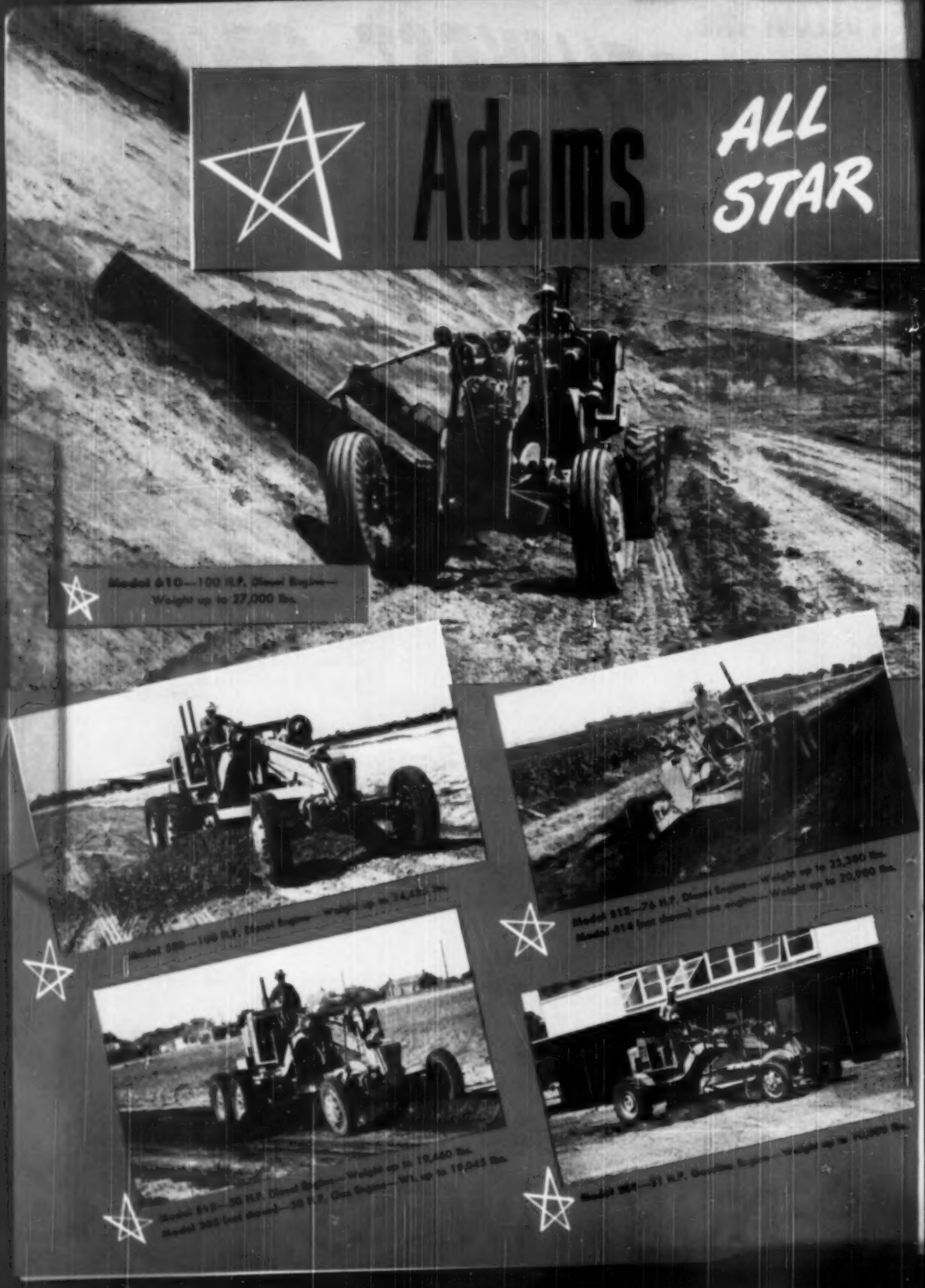
Check the names of the reputable outfits in your own area. Note that a high percentage of the successful contractors, both near you and over the breadth of the country, buy Northwests over and over again. Year in and year out, for over 25 years, one out of every three Northwests sold has been a repeat order in the hands of a responsible contractor *making money*.

Northwest Owners get the output and service *you* are looking for. Follow the Northwest Crowd and make money.

NORTHWEST ENGINEERING CO.
1503 Field Building, 135 South LaSalle St.
Chicago 3, Illinois

NORTHWEST

Adams ALL STAR



Model 610—100 H.P. Diesel Engine—
Weight up to 27,000 lbs.

Model 513—76 H.P. Diesel Engine—Weight up to 23,380 lbs.
Model 514 (not shown) same engine—Weight up to 20,980 lbs.

Model 513—50 H.P. Diesel Engine—Weight up to 19,440 lbs.
Model 505 (not shown)—50 H.P. Gas Engine—Wt. up to 19,045 lbs.

MOTOR GRADER TEAM

for 1950

For all-around usefulness and economical performance choose your motor graders this year from Adams—the world's most complete line.

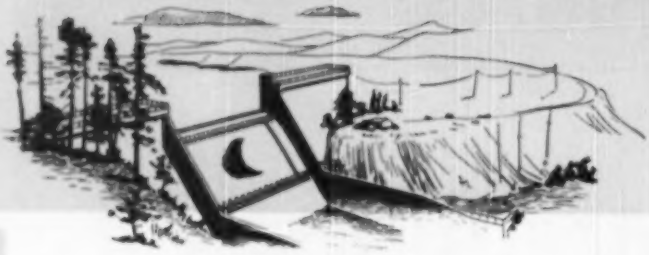
From the big extra-heavy-duty Model 610, with 100 H.P. Diesel engine, to the general utility Model 201, with 31 H.P. gasoline engine, all Adams Motor Graders are of the same proved design—all capable of the same wide range of work, in proportion to size and power.

Big operator or small—highway official or contractor—you'll find in the *All-Star* Adams team a machine exactly right for your needs or budget—a machine built to deliver the fastest, most efficient and economical performance you've ever known. See your near-by Adams dealer.

J. D. ADAMS MANUFACTURING COMPANY · INDIANAPOLIS, IND.

Make your next motor grader an **ADAMS**

Ahead of Schedule



with equipment that's ahead in performance

DORENA DAM, Oregon, begun in May, 1947, was considered a big 3½-year project. Good organization* plus job-steady "Cat" DW10s were two important reasons why completion time was shortened by almost 12 months.

Ten DW10 Tractors with No. 10 Scrapers spearheaded the "Caterpillar" fleet. Extended sides on the Scrapers enabled each to carry 11 borrow-pit yards. Averaging about 6 trips each on hauls over 4000 feet . . . including 1500 feet of adverse grade to crest of dam . . . these units moved some 570 cubic yards per hour—for a total of about 10,250 yards per 18-hour day. Two D8s served as pushing units in the pits . . . loading time less than a minute. Four additional DW10s worked on the fill, equipped with 'dozers and pneumatic-tired tampers.

These records tell a story of speed, volume—and owner-operator satisfaction. Project Manager A. H. Steiner says: "These units are unbeatable. Among their biggest features are their easy loading and ease of operation. Our boys work 9 hours a day and hardly know when lunch hour comes around."

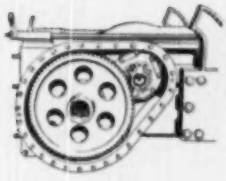
Profit-making speed and volume, little or no interrupting down time over long periods of operation, complete satisfaction—are the "end results" "Caterpillar" owners expect and invariably *get*.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

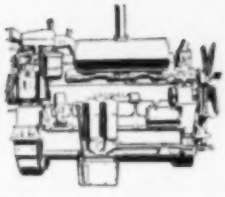
** Under the name of The Dorena Construction Co., this project was put through with the co-ordinated facilities of: G. F. Atkinson Co., Bressi & Bevanda Construction, Inc., W. E. Kier Construction Co., and A. Teichert & Son, Inc.*

Look under the hide

OF THE "CAT" DW10

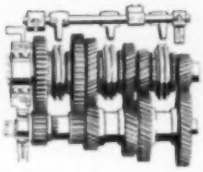


SPEEDS UP TO 24.6 MPH. Three complete ranges of speed are available with a choice of final drive gears. Many operators keep all three sets in stock to fit their DW10s to the job, ground conditions or haul distances. Differential-type rear end, combined with steering brakes, enables the DW10 to "walk" through soft spots on the fill. Full-floating drive axles are an assurance of dependable performance under the roughest of conditions.



ALL-"CATERPILLAR" BUILT. Undivided manufacturer responsibility! Engine, transmission, clutch and final drive—all are 100% "Caterpillar" built and designed for each other. The engine, 115 honest horsepower, is known the world over for its dependable and economical performance. Its own independent gasoline starting engine is itself started electrically, or can be started by hand in case of battery failure. The engine is the heart of your operations . . . use the best.

EASY SAFE OPERATION. One way to get high earthmoving production is to design equipment for safety and ease of operation. Four-wheel stability; hydraulic booster steering; selective-acting air brakes on the DW10 and trailed unit; hydraulically controlled spring-mounted seat and unexcelled visibility—these add up to all-important reasons why operators prefer DW10s.



QUALITY BUILT. Typical of the quality designed into the DW10 is the constant-mesh, easy-to-shift transmission. A gear-type pump forces oil over the upper shaft to lubricate effectively the transmission on any grade. To insure long life, a large replaceable filter element guards against destructive abrasive materials. Just one of the many features that can boost production for you.

EASY TO MAINTAIN. "Caterpillar" has always designed for ease of service. Fuel injection equipment that can be replaced like spark plugs, with no adjustments required; a metallic-lined double-disc flywheel clutch that can be removed without disturbing engine or transmission—these are just two of many reasons why owners report full satisfaction. Hundreds of well-equipped "Caterpillar" dealers, each within easy job distance, constitute another reason why DW10s boost hauling profits.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES

TRACTORS

MOTOR GRADERS

EARTHMOVING EQUIPMENT

CATERPILLAR TRACTOR CO.

Dept. RS-1, Peoria, Illinois

Please send me your latest booklet, "The 'Caterpillar' Diesel DW10 in Action."

Name _____

Address _____

_____

8 Way
Model
HD-10
86.63 drawbar hp.
Six speeds forward, to 6.03 m.p.h.; two reverse, to 4.15. Weight: 62" tread, 21,000 lbs.; 74" tread, 21,600 lbs. Available with large idler.

Let the Outstanding Advantages of These AHEAD-OF-THE-TIME Tractors Boost Your Production and Cut Your Costs...as They Have for Thousands of Owners

1 **1,000-HOUR LUBRICATION** of truck wheels, support rollers and idlers. You operate six months on a 40-hour week basis with just *one lubrication* . . . instead of daily, or even weekly, attention. Think what this means in labor and lubricant savings . . . and in working time gained! Think of the safety factor, too—no costly damage by greasing neglect.

2 **GENERAL MOTORS 2-CYCLE DIESEL ENGINE** Rugged, simple, economical, "hanging-on" power. Smooth — every down stroke a power stroke . . . less wear and tear on tractor and operator. Far less power loss than other engines at high altitudes.

3 **INTERCHANGEABLE ENGINE PARTS** Nearly all of the GM engine wearing parts are interchangeable with each of the GM engines on the various models of A-C tractors and motor graders—no matter the size. Lowers parts investment, simplifies maintenance for Allis-Chalmers fleet owners.

4 **INSTANT STARTING** GM 2-cycle diesel engines start as easily as your automobile . . . and they *start* and *operate* on *diesel fuel*. No need to let 'em idle during work-stop periods — no unnecessary engine wear or fuel waste.

Ask any owner...or arrange for a demonstration with your Allis-Chalmers dealer ..."SEEING IS BELIEVING"

Big Reasons

they're so popular

Model

HD-7

60.10 drawbar hp.
Four speeds forward, to 5.00 m.p.h.; reverse to 1.89. Weight: 52" tread, 13,830 lbs.; 63" tread, 14,000 lbs. Available with large idler.

5 **FAST MANEUVERING** 2-cycle diesel tractors are well known for their fast-working ability — not only for quickly traveling from cut to fill, but for turning around instantly in their tracks . . . and for easy maneuvering in and around tight places — especially important on bulldozing. Time saved is money made!

6 **PROPER BALANCE** Weight, speed and power are positively balanced in A-C tractors, assuring top performance on every job — pulling, pushing, lifting.

7 **OPERATOR COMFORT** All these advantages mean operator satisfaction, too — resulting in more work done more easily. Besides — he has a big, wide, comfortable seat, cushioned back, arm rests, roomy platform, convenient controls, good vision.

8 **MATCHED ALLIED EQUIPMENT** Each Allied manufacturer, skilled in his own field, works in complete cooperation with Allis-Chalmers in designing and building auxiliary equipment.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Originator of the Torque Converter Tractor

A FULL HEAPING LOAD

Every 3 minutes on a 2600-ft. cycle!

That's the production H. B. Adair Construction Company of Gardena, Calif. is getting with two LPC Motor Scrapers of the Delta-Mendota Canal job at Newman. Above—H. B. Adair registers satisfaction.

LaPLANT-CHOATE MOTOR SCRAPERS

A FEW REASONS WHY YOU'LL EARN MORE WITH LPC

- 225 H.P. Buda Diesel
- 45 H.P. Continental Starting Engine
- 12 Cu. Ft. Westinghouse Compressor
- 32 Amp. Autolite Generator
- Lipe Rollway Clutch—17"
- Fuller Transmission—4A112
- 4 Wheel Timken-Detroit Air Brakes
- Double Acting Hydraulic Steering
- Big Capacity—14 yds. struck—17.5 yds. heaped
- Positive Forced Ejection plus High Apron Lift
- Many Others

WHEN you want *real* earthmoving performance . . . the kind that rings the bell on the cash box . . . follow the lead of H. B. Adair. Make LPC Motor Scrapers *your* first choice to get more profit per yard . . . per job . . . per year.

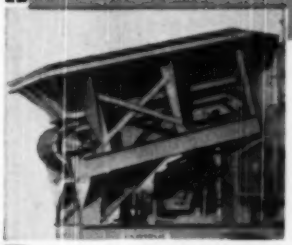
Fast loading ability and "boiling" loading action cuts seconds off loading time. Rugged power gives the unit authority to travel at top speed up and down grade in all kinds of material. Over 16 H.P. per struck yard of capacity! Speeds up to 21.2 m.p.h.! It adds up to an extra trip or two each hour . . . production that pays off. Steady, slugging performance, shift after shift, piles up money-making yardage, and keeps a penny-wise eye on production costs.

Ask your nearest LPC distributor about *all* the features that let you move dirt faster, at the lowest possible cost per yard. LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa—West Coast Branch, 1022 77th Ave., Oakland, Calif

LaPLANT CHOATE

NOW! 3 STAGES OF CRUSHING 2 SCREENS IN 1 GRAVEL PLANT

UNIVERSAL 293-QS
Greater Capacity with Real Flexibility



This apron feeder replaces scalping screen for quarry rock.

Gravel pits containing large rock are no longer a problem. Because the jaw crusher is much larger, the 293-QS takes oversize rock ordinarily rejected. Universal Engineers took the famous Universal 293-Q TwinDual Pacemaker quarry plant, removed the apron feeder, and installed a scalping screen. This screen scalps pit oversize to the primary jaw crusher and screens out sand and gravel not requiring crushing. Material requiring secondary crushing is by-passed to TwinDual Rolls.

100% chips can be produced, or finished material from the scalping screen blended with crushed material from the plant. This flexible high production gravel plant can be converted in the field to quarry operation when the situation demands. One investment provides a plant that really meets today's demands and tomorrow's changing needs. It has many other features you should know. Write for complete details.

Jaw and roll crushers, hammermills, screens, conveyors and bins in any combination—stationary or portable.

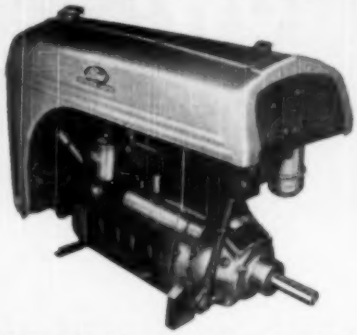
UNIVERSAL ENGINEERING CORP., division of PETTIBONE MULLIKEN CORP.

631 C Avenue N. W., CEDAR RAPIDS, IOWA
Phone 7105

4700 W. Division St., CHICAGO 51, ILLINOIS
Phone SPaulding 2-9300

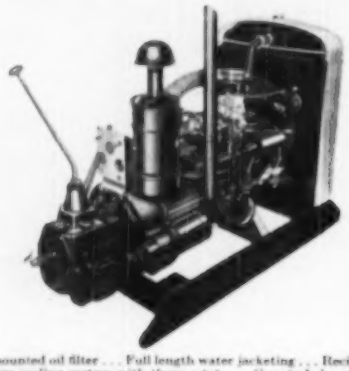
IT'S HERE...

NEW Ford "120" POWER UNIT



Removable dry cylinder liners . . . 3-ring pistons, chrome top ring . . . Moly-chrome valve seat inserts . . . Circulating cooling system with thermostat . . . Replaceable thin shell main and connecting rod bearings . . . Counterbalanced crankshaft . . . Magneto or battery ignition . . . Oil filter . . . Heavy duty oil bath air cleaner.

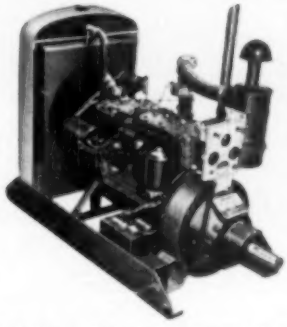
NEW Ford "226" POWER UNIT



Pad mounted oil filter . . . Full length water jacketing . . . Recirculating pressure cooling system with thermostat . . . Counterbalanced crankshaft . . . Heavy duty, replaceable thin shell copper lead bearings . . . High lift camshaft . . . Balanced carburetion (downdraft or updraft) . . . Heavy duty oil bath air cleaner.

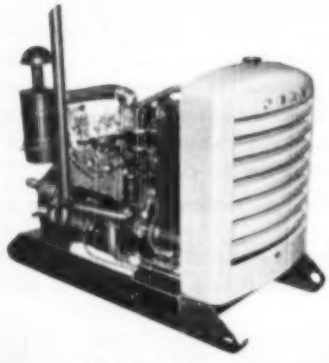
Complete

NEW Ford "254" POWER UNIT



Pad mounted oil filter . . . Recirculating pressure cooling system with thermostat . . . Autothermic pistons with chrome top compression ring . . . High lift camshaft . . . Hard faced cobalt exhaust valve (free type valves) . . . Counterbalanced crankshaft . . . Heavy duty, replaceable thin shell copper lead bearings . . . Balanced carburetion (downdraft or updraft) . . . Air cleaner.

NEW Ford "239" POWER UNIT



Dual water pumps . . . Full length water jacketing *plus* . . . Recirculating pressure cooling system with thermostat . . . Fully counterbalanced crankshaft . . . Replaceable thin shell bearings . . . Moly-chrome valve seat inserts . . . Dual downdraft carburetion . . . Oil filter and air cleaner.

RIGHT for Centrifugal Pumps . . . Arc Welders . . . Air Compressors . . . Cranes and Hoists . . . Winches . . . Railway Cars . . . Generator Sets . . . Crane Loaders . . . Feed Grinders . . . Mechanical Shovels . . . Portable Sawmills . . . Portable Well Drillers . . . Farm Combines . . . Street Flushers . . . Concrete Mixers . . . Portable Grain Mills . . . Irrigation Equipment . . . Log Yarders and Loaders—and many other applications.

Specifications of Ford Industrial Engine Power Units						
Model	Cylinders	Bore and Stroke	Displ. cu. in.	Dyn. B.H.P.	Max. Torque	Equipment Available
120	4	3⅛ x 3¼	120	38 @ 2400	92# @ 1600	Clutch; SAE #5 housing; power take-off; Ford housing; 3-, 4- or 4-speed transmission; governor. (Available as closed type power unit or engine assembly.)
226	6	3.3 x 4.4	226	80 @ 2400	182# @ 1200	Clutch; SAE #3 or #4 housing; power take-off; Ford housing; 3-, 4- or 5-speed transmission; governor. (Available as closed or open type power unit, or engine assembly.)
239	V-8	3⅛ x 3¼	239	85 @ 2400	187# @ 1600	Clutch; SAE #3 or #4 housing; power take-off; Ford housing with 3-, 4- or 5-speed transmission; governor. (Available as closed or open type power unit, or engine assembly.)
254	6	3.5 x 4.4	254	95 @ 2400	212# @ 1200	Clutch; SAE #3 or #4 housing; power take-off; Ford housing; 3-, 4- or 5-speed transmission; governor. (Available as closed or open type power unit, or engine assembly.)
337	V-8	3½ x 4½	337	117 @ 2400	257# @ 1600	Clutch; 5-speed direct-o-fifth transmission overdrive transmission; direct drive power take-off. (Available as closed or open type power unit, or engine assembly.)

FORD

Industrial Engine Power Units ARE RIGHT 3 WAYS for your job!

1 **RIGHT POWER**—five great models in wide variety of units. Each one ready to run!

2 **RIGHT FEATURES**—all the latest advancements of Ford's famed progressive engineering.

3 **RIGHT SERVICE**—as near as your nearest Ford Dealer, clear around the world.

Line of NEW

Ford INDUSTRIAL ENGINE

POWER UNITS!

NEW Ford "337" POWER UNIT

Drop forged fully counterbalanced crankshaft, hardened journals . . . Heavy duty, replaceable thin shell copper lead bearings . . . Hard faced cobalt exhaust valves (free type valves) . . . Autothermic pistons, chrome top ring . . . Dual centrifugal water pumps . . . Full length water jackets . . . Recirculating pressure cooling system with thermostat . . . Dual downdraft carburetion . . . Oil filter and air cleaner.

Ford Industrial Power Units are now available in five great models . . . four, six and V-type eight cylinder . . . 120 to 337 cu. in. displacement. *COMPLETE* with radiator . . . instrument panel and S.A.E. or Ford type housings. Foot or skid mounted. Closed and open types. Made throughout to Ford's famed hi-precision manufacturing standards. Completely tested and *READY TO RUN!*

Ford Dealers, Ford District Sales Offices and the Ford Industrial Engine Department are at your service in developing engineering recommendations showing how Ford Industrial Power Units can be most effectively applied to your job. *Mail coupon below for Ford Industrial Power Unit Folder.*

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED

For Special Literature on Ford Industrial Power Units, use this coupon . . .

Industrial Engine Department

FORD MOTOR COMPANY

DEARBORN, MICHIGAN

Send me comprehensive literature about the new Ford Industrial Power Units. Address: **Industrial Engine Dept., Ford Motor Co., Dearborn, Mich.**

NAME _____
(Please print)

STREET _____

CITY _____ STATE _____

The New SEAMAN MIXER

THE PRIMARY EQUIPMENT FOR ALL MAJOR BITUMINOUS, SOIL-CEMENT AND ALL SOIL-STABILIZED *Projects!*

THE SEAMAN SELF-PROPELLED PULVI-MIXER

Close-coupled, short turning radius; single or dual transmission gives 3 to 7 mixing forward speeds plus road-gear and reverse. Wide visibility for operator. All controls in instant reach.

Yes, — large *projects* that have been handled by states, municipalities, counties and contractors such as these, — where *all* mixing was SEAMAN-produced: Andrew Scherer, contractor, N. C. (soil-cement); Davis Construction Co., contractor, N. Y. (bituminous); Standard Concrete Pipe Co., Cal. (Soil-cement); Cascade County, Montana (re-claiming oil mat); City of Birmingham, Mich. (asphalt); State of North Carolina . . . check with any or all of them about high production and fine quality mixing by the SEAMAN.

In short, the SEAMAN brings "plant-mix quality at *lowest* road-mix cost."

These new quality-mixing records are due to selective speed transmissions that match mixing speeds exactly to materials.

THE SEAMAN SELF-PROPELLED TRAV-L-PLANT

All the advantages of Self-Propelled Pulvi-Mixer plus spray bar, pump, pump tachometer and tachometer wheel for accurate, no-migrating, no-evaporating admixture of bitumen or water most efficiently just ahead of rotor. Single or dual transmission, like Self-Propelled Mixer gives mixing speeds to match all conditions.

TWO NEW BULLETINS!

One on the Seaman Self-Propelled Mixer and Trav-L-Plant—the other on the Seaman Pull-Type Mixer. Yours on request. Complete details. Send for them now.

THE SEAMAN PULL-TYPE PULVI-MIXER

Here selective speed transmission controls rotor-speed to obtain best mixing despite variables in speed of towing tractors. Can easily be equipped with spray bar, pump and tachometer wheel for bitumen or water taken from transfer or tank truck.

SEAMAN MOTORS, INC.

291 N. 25th St., Milwaukee 3, Wisconsin

Your Trucks Deliver More—for Less with EATON 2-Speed Axles

Eaton 2-Speed Axles give you both pulling power and speed in the same vehicle—instantly available to meet every specific operating need. Your trucks do more jobs, make faster trips. With Eaton 2-Speed Axles, engines run at most efficient and economical speeds; operating and upkeep costs are reduced to a minimum; thousands of miles are added to vehicle life. And Eaton's planetary design adds thousands of miles to axle life! Gear tooth loads are better distributed; gear speeds are slower; stress and wear are reduced to a minimum. Eaton 2-Speed Axles are available for most trucks of the 1½-ton class and larger. Ask your truck dealer for a road demonstration.

Axle Division

EATON MANUFACTURING COMPANY

CLEVELAND, OHIO

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS

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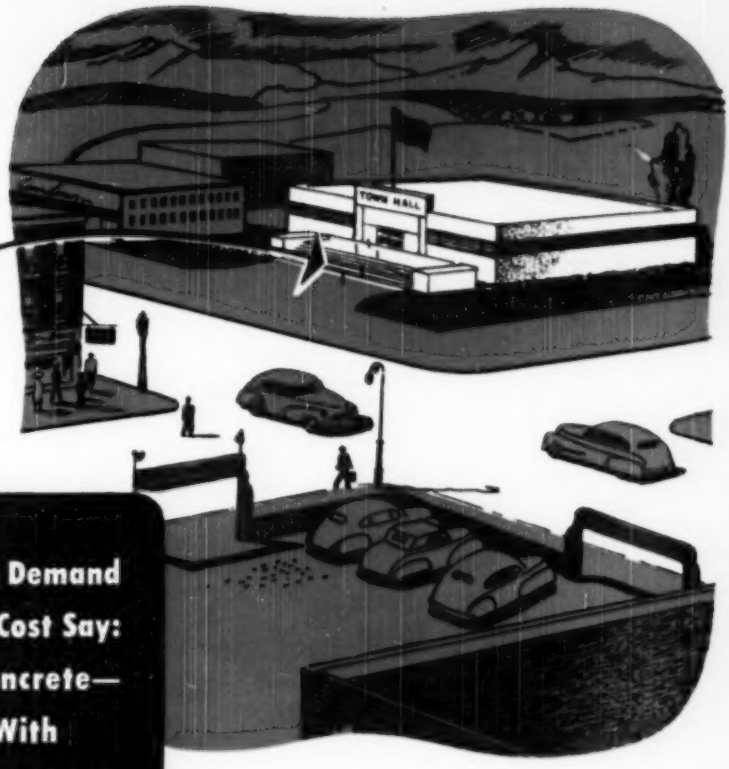

City Fathers Who Demand Long Wear—Low Cost Say: "Pave It With Concrete—Reinforced With CLINTON WELDED WIRE FABRIC"

Towns all over America are saving money—whipping maintenance problems—taking the lead over many big cities. Municipal executives who weigh the cost and performance of *all* types of street surfacing discover these facts:*

1. **Concrete usually costs less to lay down than any other surface of equal load carrying capacity.**
2. **Concrete costs less to maintain than any other surface.**
3. **Concrete lasts longer—carries peak loads for 25 years—and more.**

Clinton Welded Wire Fabric gives streets and highways a "Backbone of Steel"... can be laid economically, it resists cracking and temperature changes, helps to support heavy loads, and increases durability. To take full advantage of all benefits, wise city executives specify that concrete, reinforced with Clinton Welded Wire, be used.

For complete information on how Clinton Welded Wire Fabric will make your concrete streets and highways better, write to our nearest district office.

*Portland Cement Ass'n

OTHER CF&I PRODUCTS: REALOCK FENCE, WICKWIRE ROPE, CUTTING EDGES FOR SCRAPERS, DOZERS, GRADERS AND SNOWPLOWS

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The Colorado Fuel and Iron Corporation

GENERAL OFFICES: DENVER, COLORADO

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ON THE PACIFIC COAST: CALIFORNIA WIRE CLOTH CORPORATION, OAKLAND 4, CALIF.

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CLINTON
WELDED WIRE

WELDED WIRE REINFORCEMENT

Specifications:

WIRE: Shall conform to the Standard Specifications for cold-drawn Steel Wire for Concrete Reinforcement (A.S.T.M. Designation A-82) of the American Society for Testing Materials.

FABRICATION: Assembled by automatic machine which assures accurate spacing and alignment of all members; all wires securely connected at intersections by a process of electrical-resistance welding; the entire operation in accordance with Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement (A.S.T.M. Designation A-185-37).

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Longitudinal Wires No. 14 Gauge to No. 000 Gauge.

SPACING RANGE: Transverse Wires 2" minimum increasing to 16" maximum by 1" increments (excluding 11", 13", and 15" spacings).
Longitudinal Wires 2" minimum increasing by ½" increments.

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Mats—Length as required (suitable for loading on cars).

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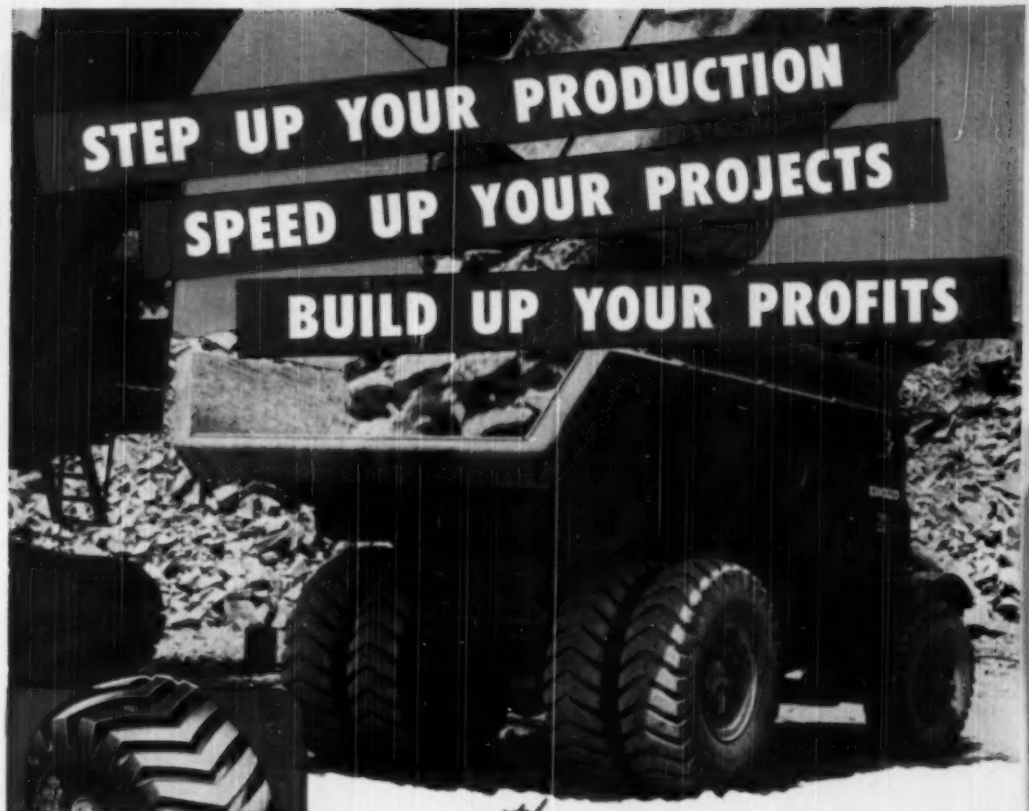
PACKAGED: In Mats or in Rolls.

The Colorado Fuel and Iron Corporation
GENERAL OFFICES: DENVER, COLORADO
On the Pacific Coast: California Wire Cloth Corporation
1080 19th Ave., Oakland, California



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Firestone Tires

WHEN you're racing against time, there's nothing more costly than tire trouble. When tires go down, costs go up — and fast! There are just two means of relieving these tire headaches: one is through better tires, and the other is through better tire service. Firestone offers both.

Firestone tires are precisely engineered, both in body construction and in tread pattern, for your job. The cut-resistant treads are extra thick and extra tough. The bodies, armored by four "punch-protector" plies and double-thick sidewalls, are made of heavy, high-tensile, low-stretch, Gum-Dipped cords.

Your Firestone representative will recommend the right tires for your job, and will follow through and see that you get every dime's worth of built-in extra value. Let him prove it.

Listen to the Voice of Firestone every Monday evening over NBC

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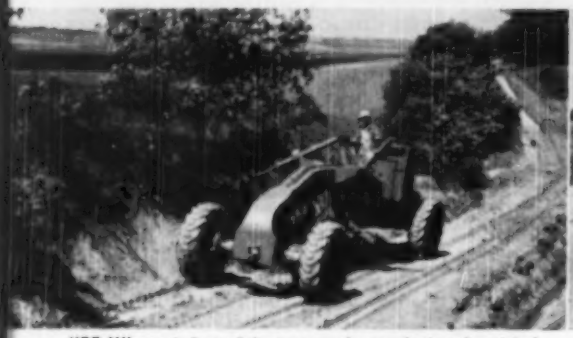
WHEN YOU BUY REPLACEMENT TIRES OR NEW EQUIPMENT INSIST ON FIRESTONE OFF-THE-HIGHWAY TIRES

BUILT TO

The Power Graders That Have Everything

"88-H"—a new model which brings to the field of motor graders of medium size the extra traction and power-at-the-blade of all-wheel drive, and the unequaled maneuverability of all-wheel steer.

The Austin-Western Power Grader of today owes its matchless performance to *completely effective* use of power. Through All-Wheel Drive, every pound of weight is a powered pound, harnessed to a driving wheel—and contributing every ounce to tractive effort. This tremendous traction—perfectly directed and controlled through All-Wheel Steer—provides superb earth moving ability, and mastery of all types of work. Additional values are offered by specialized attachments, which greatly increase the usefulness and day-in and day-out profit making ability of the graders.



"99-H"—out in front of the motor grader parade since the original "99" of 1937. Popular with contractors and highway departments for its all-around performance, under all conditions, in all seasons.

MASTER "99"—another new model, combining all of the time- and money-saving features of the "99-H" with the extra power, traction and road speed of its 100 horsepower engine.

Model "40" Sweeper

Fast, maneuverable, and economical in operation. No troublesome, expensive conveyor or elevator to keep in adjustment and repair—dirt is thrown directly into the 2-yard hopper. Can be equipped with either right-hand or left-hand gutter broom or both. The Leaf Broom attachment simplifies the collection of heavy accumulations of leaves.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.

OUTPERFORM

Crushing, Screening and Washing Plants

PORTABLE . . . STATIONARY

The AUSTIN-WESTERN LINE includes Jaw Crushers and Roll Crushers in a wide range of sizes; plus matching screens, elevators, conveyors and bins. Exclusive features increase output, assure constant operation and reduce maintenance costs. Skilled engineering characterizes each and every Austin-Western crushing, screening and washing plant, which is tailor-made to a particular production problem. We would welcome the opportunity to discuss yours.

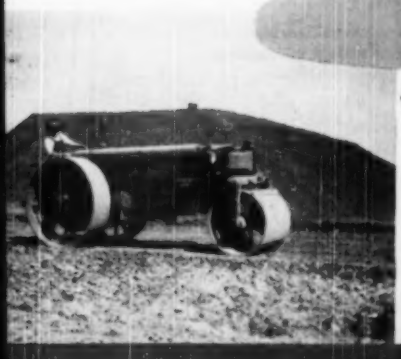
"Badger" Convertible Shovel

"SWINGS LESS TO MOVE MORE"

With the Badger, only the bucket, boom, turntable and mast swing. The heavy main deck, engine, transmission and main frame are STATIONARY—to counterbalance heavier loads and avoid objectionable tail-swing.

The Badger makes more swings per minute, day, month and year . . . wastes no fuel or power swinging extra weight . . . digs the hardest "diggable" material . . . can work in closer quarters.

Road Rollers



3-WHEELED ROLLERS have full length side plates for maximum rigidity; low center of gravity for smooth operation, and hydraulic power steer. All may be had with gas or diesel engine.

TANDEM ROLLERS. Variable weight type—in 5-8 ton and 8-10½ ton sizes. Important improvements provide exceptionally smooth and steady performance on precision jobs.

Austin-Western

Figure what a bag of cement *really* costs you!

There are hundreds of contractors and ready-mix operators who continue to handle bag cement because they have not figured its complete cost. They are not familiar with the line of Erie Portable Cement Handling Plants (172 bbl. to 600 bbl. capacity) and Semi Portable Bins of larger capacity that unload bulk cement from gondola cars. These plants can be knocked-down and moved to the job and give you that big advantage that fast, economical and accurate handling of bulk cement gives to larger operators. Let's have your problem and we'll show you how to pay for it out of savings over bag handling.

1. Estimate difference in first cost. Bag vs. Bulk. Jot it down . . . . . _____
2. Estimate cost of unloading Bags. $\frac{\text{No. of sacks}}{\text{Man hours}}$ x hourly rate = _____
3. Estimate cost of charging Truck Mixer. $\frac{\text{No. of sacks}}{\text{Man hours}}$ x (hourly rate of men + Mixer @ $6.00 /hr.) . . _____

   Your mixer time is worth say about $6.00 /hr. and the rent it takes to charge it with bag cement should be computed. Bulk Cement batching is fast and accurate.
4. Estimate cost of Loading Sheds—you won't need them with bulk handling. . . . . _____
5. You cannot figure how much you lose by guessing or splitting bags. Write in Total

and tomorrow . . . send for data and Catalog

ERIE

STEEL CONSTRUCTION COMPANY

301 GEIST ROAD • ERIE, PENNSYLVANIA

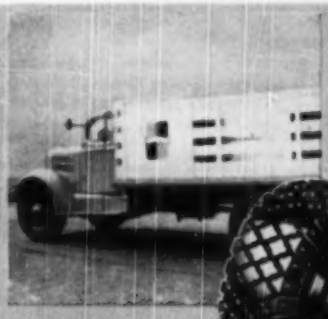
OVER ROUGH JAGGED ROCKS–IN MUD, GRAVEL, SAND–ON SMOOTH HIGHWAYS–

Generals meet all requirements

Where you have to go in off-the-highway to get the load, bring it out and over the road, use the *General H. C. T.* The sturdy, zig-zag tread digs deep for more traction in toughest going. Carries loads faster, safer, cheaper over the highway.

Where the job calls for most work off-the-highway use the *General L. C. M.* Tremendous lugs of rubber, designed in a self-cleaning tread, take bruising punishment under toughest conditions; carry the load over-the-highway smoother, safer, faster, cheaper.

General Tractor Grader Tire. Thick lugs of rubber set high on a sturdy carcass develop extra drive-wheel traction. Deep-ribbed General Ribbed Grader for front or trailing wheels steer easier, forward or backward.



For utility trucks choose the sturdy General All-Grip truck tire. Extra-deep, extra-thick tread blocks develop fast, self-cleaning action for more traction on mud and gravel roads —smooth rolling on the highway.

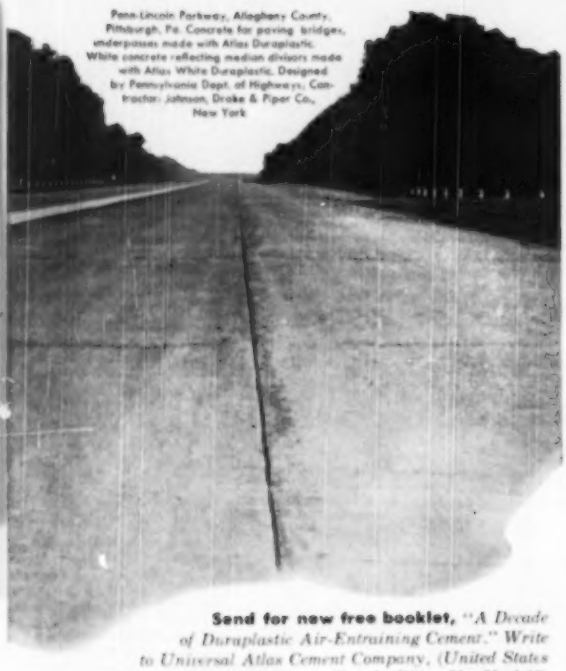
The GENERAL TRUCK TIRE

Ten Years Ago...

in August, 1939, this concrete test paving was laid in Second Avenue North, Minneapolis. The badly scaled section of roadway in the background was made with regular portland cement. The foreground section, *laid at the same time*, was made with Atlas Duraplastic—the first commercial use of the air-entraining portland cement originated and developed by Universal Atlas.

Both sections, subjected to the severity of ten Minneapolis winters and to heavy applications of de-icing salts, are shown above as they appeared in July, 1949—convincing proof of the characteristic durability of Duraplastic concrete, of its high resistance to freezing-thawing weather and the scaling action of de-icing salts. Longitudinal structural crack shows some cavelling. Note perfect transverse joint.

Today.... No doubt of *durability*... in concrete paving made with ATLAS DURAPLASTIC*



Penn-Lincoln Parkway, Allegheny County, Pittsburgh, Pa. Concrete for paving bridges, underpasses made with Atlas Duraplastic. White concrete reflecting median divisors made with Atlas White Duraplastic. Designed by Pennsylvania Dept. of Highways. Contractor: Johnson, Drake & Piper Co., New York

From its initial installation to the succeeding score upon score of successful paving installations over the past ten years, there is abundant evidence that Atlas Duraplastic cement fortifies concrete against freezing and thawing—renders it highly resistant to the scaling action of de-icing salts.

Clinching proof was revealed at the first session of the American Concrete Institute Convention held in New York in February, 1949. Devoted to "problems in concrete paving surface durability," the session recorded a significant unanimity of opinion that air-entrained concrete resists pavement scaling from salt treatment. A leading construction magazine commented, "... the use of entrained air, insofar as designers and contractors are concerned, would seem to admit of no more argument than the use of the water-cement ratio."

Experience shows Duraplastic (1) requires less mixing water for a given slump; (2) makes concrete more plastic, more cohesive, more uniform; (3) minimizes segregation and bleeding; (4) produces more workable concrete that dumps and screeds easily; (5) permits finishing closer to paver, and allows earlier protection for curing.

For pavement needs of today and tomorrow, Duraplastic offers *better concrete at no extra cost*. It provides the precise amount of air-entraining agent interground with the cement for satisfactory field performance. It complies with ASTM and Federal Specifications, sells at the same price as regular cement and calls for no unusual changes in procedure.

Send for new free booklet, *"A Decade of Duraplastic Air-Entraining Cement." Write to Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), Chrysler Bldg., New York 17.*

OFFICES: Albany, Birmingham, Boston, Chicago, Dayton, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Waco.

**"Duraplastic" is the registered trade mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.*

135-D-66

ATLAS DURAPLASTIC TRADE MARK REG. U. A. C. CO.

AIR-ENTRAINING PORTLAND CEMENT

MAKES BETTER CONCRETE AT NO EXTRA COST

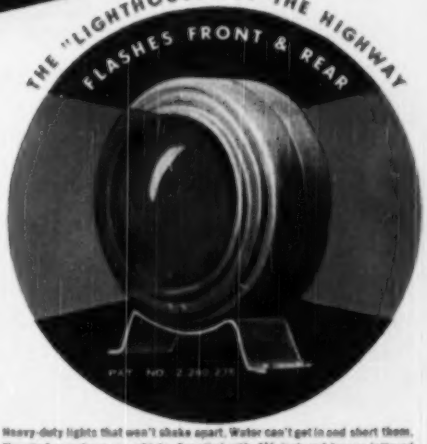
"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries*—*Sunday Evenings*—*NBC Network*

Keep your safety record clean

install Keystone Flashing Lights on all your vehicles

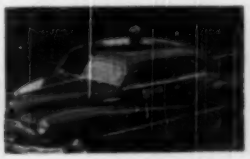
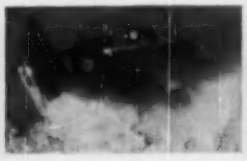
The high visibility of Keystone Flashing Lights shout a warning of danger ahead. They flash 80 "STOP" warnings per minute to both front and rear —two ways at once. Built like battleships. Withstand punishing service encountered in rough-riding snow plow operation to give uninterrupted trouble-free service year after year. Install Keystone Flashing Lights on ALL your vehicles. Make this year the safest your department has ever had.

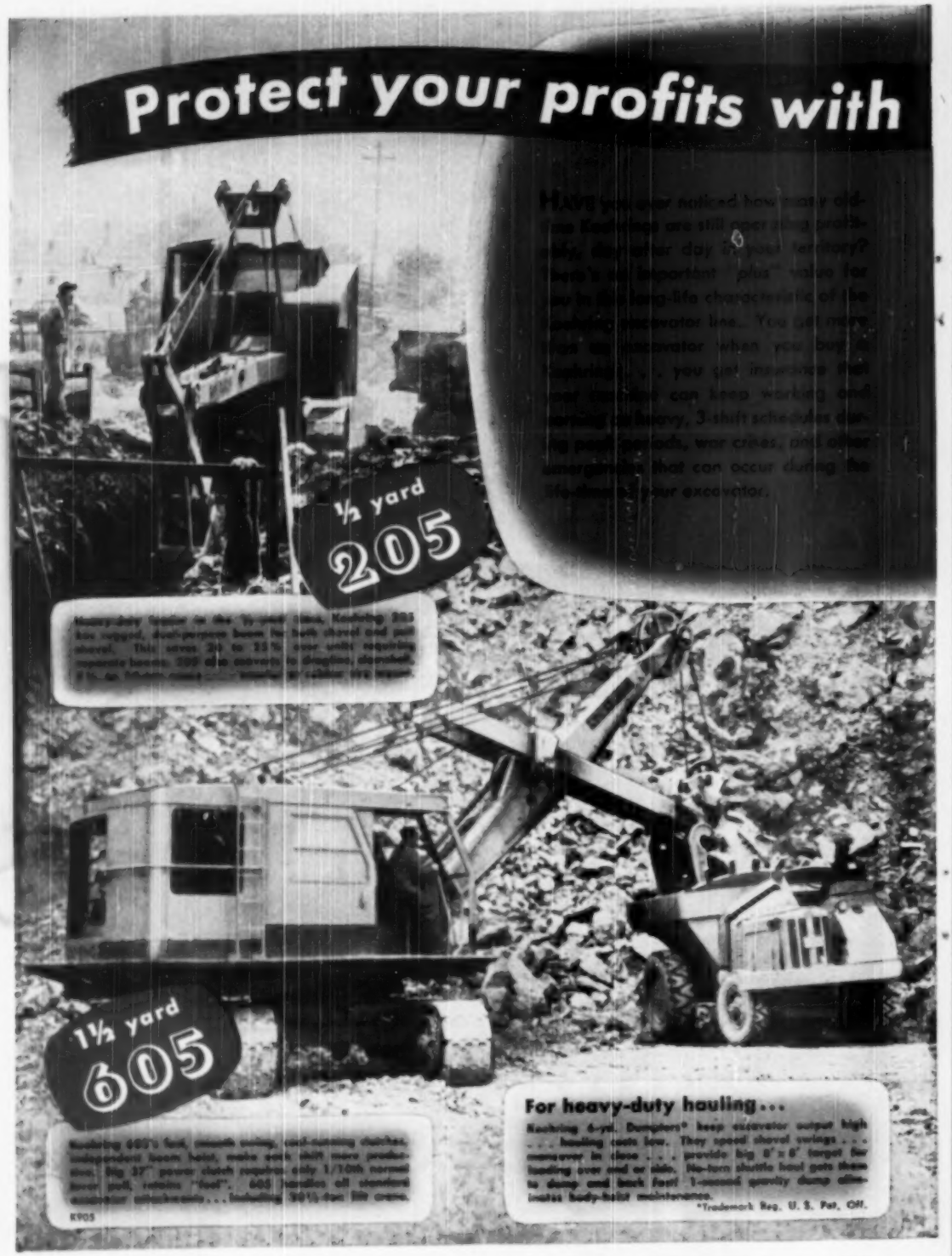
Auto Gear & Parts Co., Inc.
16th St. & Hunting Park Ave. • Philadelphia 40, Pa.



Heavy-duty lights that won't shake apart. Water can't get in and short them. Mounted anywhere on vehicle. Supplied with 8½ inch red lenses lettered "STOP" or with plain red, amber or blue lenses for 6 and 12 volt systems.

KEYSTONE *FLASHING* LIGHT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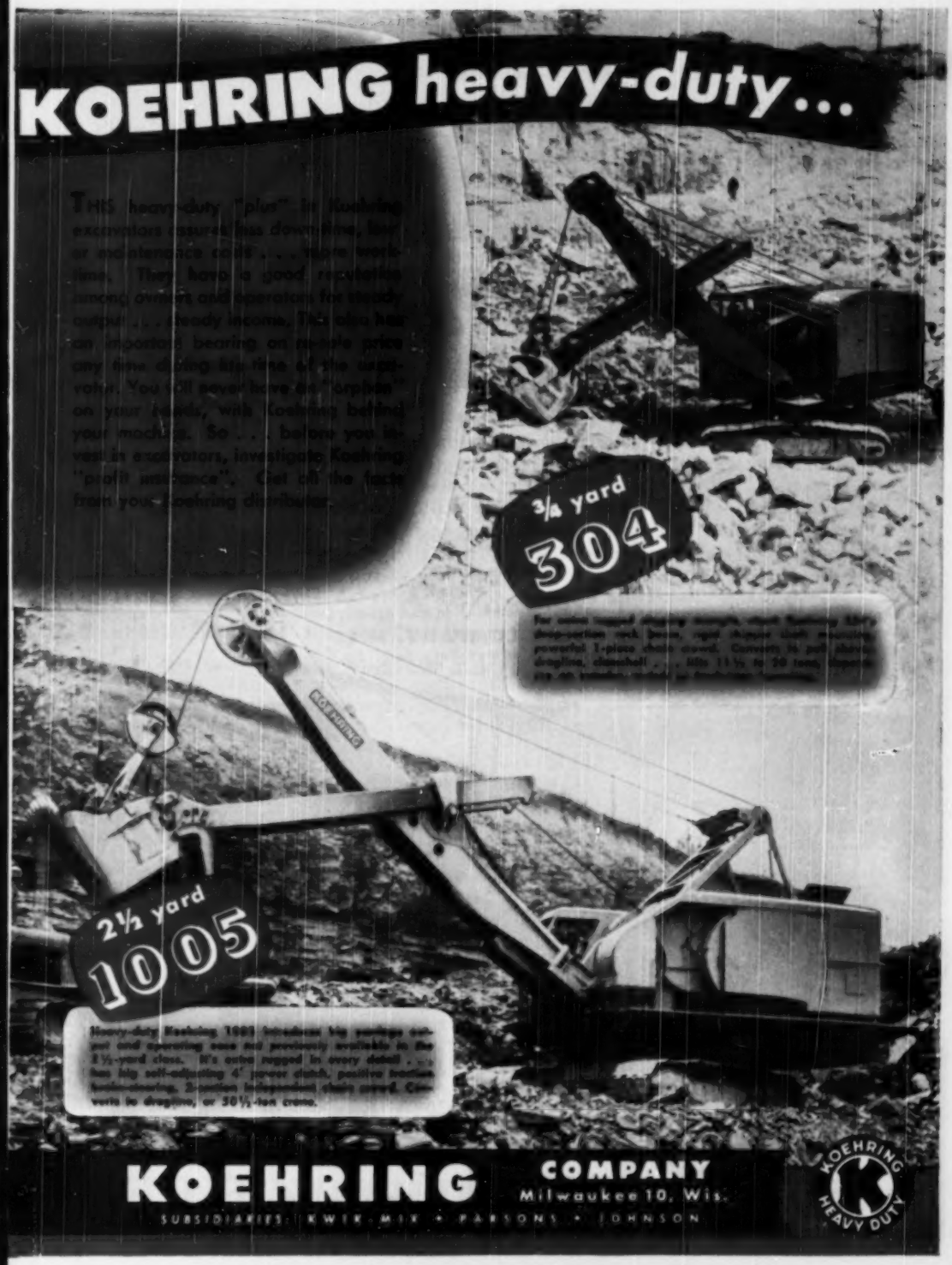

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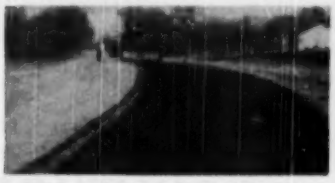

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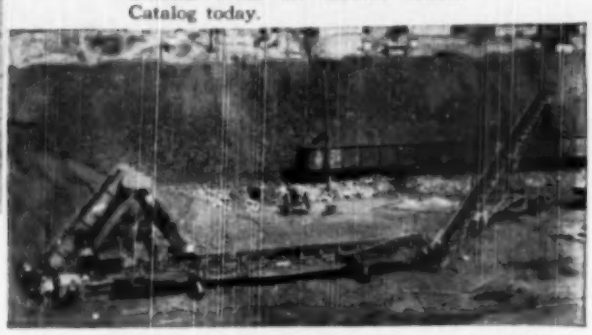

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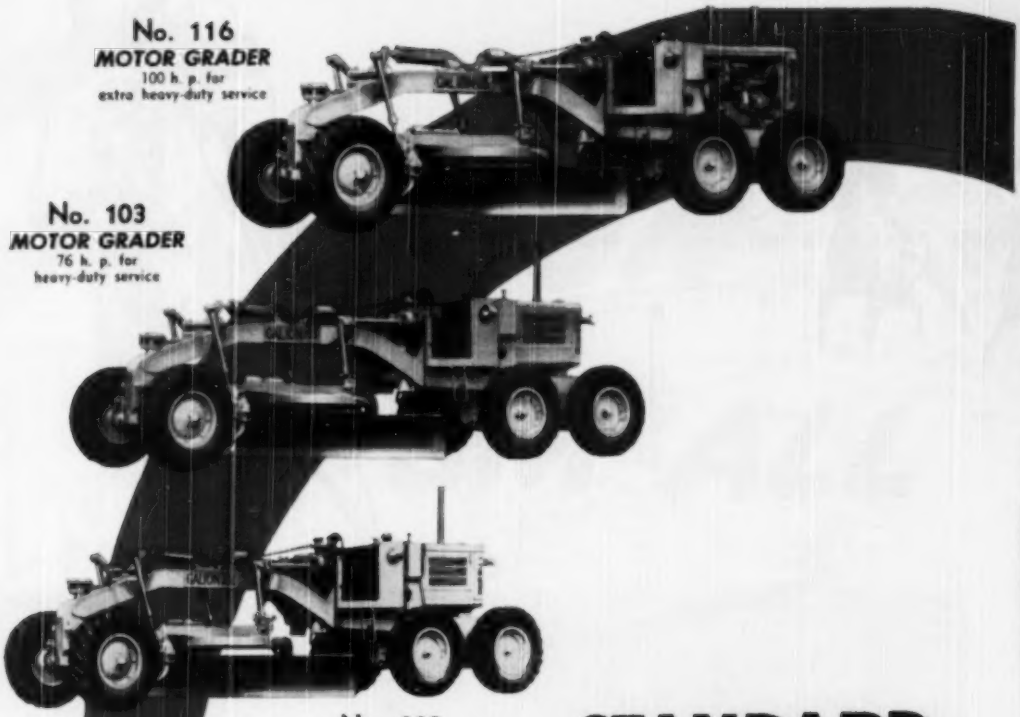

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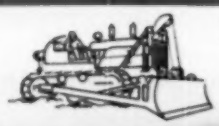
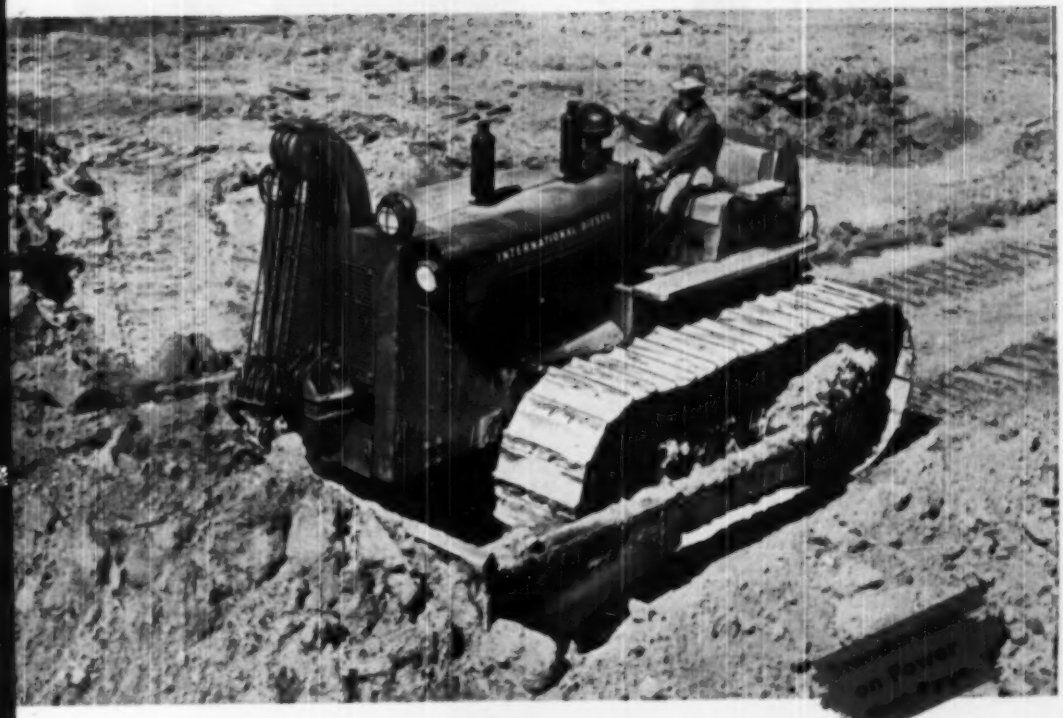


CHAMPION OF 'EM ALL



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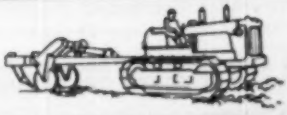

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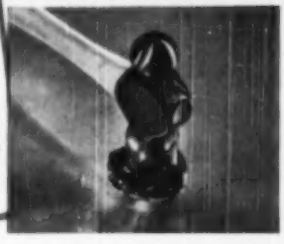

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ROADS AND STREETS

January, 1950 • Vol. 93 • No. 1

Rock All the Way

Virginia's "Toughest" Road Grading Job

One-shovel outfit using shuttle-type rock trucks moved as high as 9,000 cu. yd. weekly. Blasting a problem near power plant

THESE days a 66,000-yd. excavating job doesn't sound big, and a project 1.15 miles long seems puny. But a piece of road work involving this yardage and length proved quite a tussle for Ralph E. Mills Co., contractors of Salem, Virginia. The job in question, graded and surfaced during 1949, eliminates the last unimproved link of State Routes 130 and 501 along a rugged hillside flanking the James River.

The old road clung to rocky ledges at the base of almost sheer mountainside cliffs through the Blue Ridge Mountains and along the James River. The new line rises as high as 100 ft. up the hillside, and ledge methods were required most of the distance.

This project, characterized by Virginia engineers as offering "extreme construction difficulties," is reminiscent of the U.S. Route 220 project completed also in 1949 near Clifton Forge, Va. ["Sand Wells Installed as Slide Preventive on Virginia Road Relocation"; July '49 R&S].

Wagon Drills on Planks

Timber scaffolding was required at many locations to hold the wagon drills in position for the first lift. Pioneer jackhammer work was performed by men tied to ropes anchored to stumps at the top of the slope. The air lines also had to be held in suspension or snubbed with ropes.

Most of the material was shale, with some hard quartz and granite. Drill holes varied from 6 to 24 ft. in depth, and charges as high as 2500 lb. of explosives was used per blast, the ratio averaging slightly over 0.5 lb. per cu. yd. of materials. Atlas 40% Giant Ammonia Gelatin was largely used, with Atlas Accordion Fold electric caps.

Blasting was a cause of considerable concern as the work approached the Snowden power house. Caution was necessary not only because the roadway passed within a few feet of the power station, but also because of the existence of a power tunnel immediately under the existing Route 501 roadway. Blasting in this area was controlled principally by drilling sufficiently deep (about 24 ft.) so that moderate loading resulted in loosening the ledge, after which the stone was shattered by means of numerous small shots.

Rock equipment consisted of 3 Cleveland wagon drills, 6 jackhammers (Cleveland, I-R and Thor), 3 Gardner-Denver compressors (2 365's and a 500) with Caterpillar diesel engines, and various service equipment.

Shovel Access Problem

Excavation was performed by a single Koehring 1½-yd. shovel equipped with a Pettibone Mulliken bucket. Speed of the project was limited by the difficulty of access to the shovel

★ Wagon drill operators often began work with the help of scaffolding

Rock Excavation Methods

In addition to the accompanying article, see also "Selection of Rock Drilling Equipment," and "Sizing of Excavators vs. Hauling Equipment" elsewhere in this issue.

★ Getting to the shovel was one of the chief problems in the early stages

★ At the dump—a single dozer had time between loads to help make trail and trim the grade

★ Air line pipe being anchored in suspended position by ropes from nearest tree

★ Six wagon drills were required to keep ahead

★ Showing the difficult ledge conditions encountered. *(Left)*: Wagon drill scaffolding seen at top. *(Right)*: Jackhammer being used on a large outcropping. (These photos by T. M. Spencer, inspector)

★ Two 365 cfm. and one 500 cfm. compressor proved sufficient for the Route 130 job

★ "Back house"-like shack, built on rear corner of the fuel truck, serves as a rain protection during tank filling operations. Refueling a compressor is in progress here at the spot circled in the adjacent scene

during the early stages. Three Koehring Dumptor rock trucks were used, proving well adapted to the narrow, steep haul roads. Production averaged 800 cu. yd. per day during the first slow going, gradually increasing to 1,500 cu. yd. daily as the ledge widened out.

A D8 and a D6 Caterpillar tractor with Caterpillar dozer equipment spread stone at the dump. The job was marred by one mishap when a dozer was buried under a slide, the operator however leaping to safety.

The contract price of $166,000 included grading for a width of 30 ft. in cut (32-ft. fill section) and placing bituminous surfacing. Excavation price was $1.18. A 180-day limit was met successfully, and after the first 50 days the grade was made accessible to mail delivery, as per contract.

An interesting item was the widening of a 20-ft. span concrete barrel arch under Route 501, to provide sufficient length for the deepened roadway fill. Steel sheeting was driven on the end adjacent to the power reservoir, and excavation kept de-watered with 4 Gorman-Rupp 4-in. and 1 Jaeger 6-in. pump units. An 80-ft. line of 48-in. corrugated pipe carried low-water stream flow through the work. The 700 cu. yd of concrete required was supplied by a 4-sack CMC mixer, and a Bucyrus-Erie 22-B crane handled forms and swung the concrete bucket.

T. M. Spencer was inspector for the Virginia department of highways and M. A. Howery was contractor's superintendent.

260 Miles of Walks Built in Chicago

Property owners have replaced 260 miles of unsafe sidewalks in Chicago in the last 18 months, according to Robert C. Quirk, city sidewalk superintendent. Quirk estimated that there are about 580 miles of dangerous sidewalks in the city, with 3,300 miles in need of rebuilding or major repair. In 1948, the city's inspectors condemned 5,327 stretches of walk. Notifications were sent to 8,500 property owners. The city's sidewalk program will continue in 1950.

★ How the ledge road looks on an adjoining project completed since the war

★ Culvert widening in progress for new high-level, widened grade

★ M. A. Howery, contractor's superintendent, and T. M. Spencer, inspector

EDITORIAL

★ Safety Work Isn't Just for the Big Fellows

"We're too small an organization to do anything fancy about safety." Remarks such as this have been made to us several times in recent months by contractors. Such remarks give us the impression that contractors think organized attention to worker safety is necessary or practicable only where large crews are engaged. Common sense analysis shows that this isn't so. Why is it then that smaller contractors give so little formal attention to accident prevention on their jobs?

There are innumerable reasons, of course. One is the feeling "It can't happen to us." Also, contractors may have the impression that they can't afford the luxury of a safety program. Yet any contractor large enough to have a foreman, or even if he is his own foreman, can do ordinary simple things every day to cut down the chances that time delaying accidents will occur on his jobs.

One of the best helps to come along on this subject is the new manual of safety talks for construction and maintenance foremen, published by the construction section of the National Safety Council. This manual contains 58 short talks on various safety subjects such as first aid, personal protective equipment, avoidance of mishaps with heavy equipment, and so on. These talks are merely suggestions for foremen in gathering their men around them, to discuss safety matters man-to-man for a few minutes in language that the average worker can understand.

The Council's committee under Bob Moore's direction is to be congratulated on this fine piece of work. Every organization engaged in construction work or in highway, street or airfield maintenance can profit by this manual and, incidentally, in membership in the National Safety Council itself. The manual is available to non-members as well as members, and we suggest that you write the National Safety Council, 20 North Wacker Drive, Chicago 6, Ill., for details.

★ New Emphasis on Surface Qualities

Threaded all through the recent Highway Research Board meeting were evidences that highway technicians are turning more and more to the poor motorist. Slipperiness is recognized for what it is—a daily nation-wide game with the undertaker for the road user, and an admission of failure on the part of designers, construction men, maintenance men, or all three, throwing in the administrator for good measure.

Slipperiness, notes a committee report, is a more serious problem than ever because of faster road speeds, more crowded traffic, and more wide-spread use of bituminous surfaces. Such surfaces are the most common reason for the signs "Slippery When Wet," and many a state, county or city highway force still has no real control over such factors as bitumen content, aggregate gradation and uniformity, amount and kind of sealing material and chips, and so on. Rule of thumb methods simply must give way to close laboratory control, and a resurface project or sealing program is worthy of every bit as much advance analysis and planning and preparation as a new construction project.

Forty million car and truck owners will be glad to know that the ball has really started rolling to learn more about the whole subject of the surface, including not only slipperiness but other characteristics, particularly night visibility and smooth-riding quality.

★ On Publishing Estimates

(By E. C. L. Wagner, in "The Construction Advisor" published by the Associated General Contractors of Missouri, Jefferson City)

Publishing the engineer's estimate on highway construction has recently been commended in certain quarters. One publication reports that making the estimate available before lettings in Illinois saved approximately 8½% over the price paid for contract work in 1948. The published report overlooked the fact that prices throughout the United States came down about 6% in that same period, and that prices in one other state where estimates are not disclosed came down 9%. Here in Missouri the contracting industry agrees with State Highway Director Kauer of Ohio, who, in the middle of the year, abandoned the previous practice of publishing the engineer's estimate. Mr. Kauer stated "we want the contractors to bid what they think a job is worth, and not to bid against our estimates." An estimate made by a highway engineer has nothing whatever to do with the price for which a contractor can do the work. The lowest amount for which any one firm can do a certain piece of work and make a satisfactory profit, pitted against the bid of other equally competent competitors, is the American competitive system which has created the present day efficient contractor. And the opinion of a public official as to what he guesses the work might cost has nothing to do with increasing the efficiency of any contractor or with bringing down the cost of the work or the contractor's bid price.

High-Speed Street Patching Methods

Modern mobile equipment, thorough advance planning, coordination of functional crews, and long experience enable Washington, D. C., street contractor to cover 23 to 35 repair locations per day

★ Although average patch cuts measure 2' x 3' or 2' x 4', some are much longer, running 100 to 150 ft. in length

By Martin B. Jaeger,
Special Correspondent

McGUIRE & ROLFE, Inc., paving contractor of Washington, D.C., has developed a fast-moving routine for handling pavement patching operations in the District of Columbia. At its best, the new method has established a record of 35 street locations repaired in a single 8-hour day—a feat which involved pouring about 45 cu. yd. of concrete and traveling some 85 miles over Washington's traffic-crowded streets.

The McGuire & Rolfe method lies partly in the use of equipment which provides a real touch of mechanization. Also significant is the precision coordination between the various crews which attack the repair work in tightly-timed successive waves. There's rarely a lull, for one crew follows directly on the heels of its predecessor, whips through its particular specialty, and moves on to the next location to repeat the process.

At 7:30 a.m. on each working day the crews roll out of the contractor's yard armed with a "scout sheet" listing the day's locations. The breaker crew, numbering four men, is first. Its equipment consists of 1 315-cfm Ingersoll-Rand air compressor mounted on a GMC truck, 4 jackhammers (Ingersoll-Rand CC-80's and Cleveland C-7's), and plenty of lumber to set up as road blocks around the patch jobs.

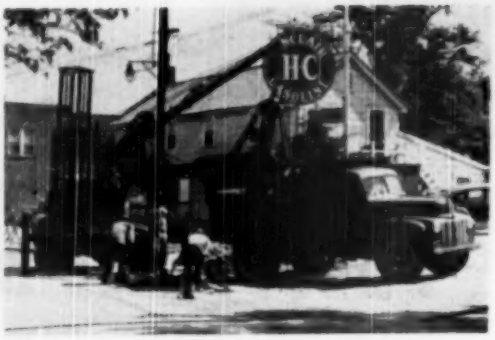
Step 1—Breaker crew marks outside limits of cut to be made for street patch

Pavement Breaking Methods

The first step for this crew, on reaching location No. 1, is to mark out the outside limits of the proposed cut. Then each of the four men handles a jackhammer to break the pavement within the marked limits. One of the hammer operators goes over the marked lines, making a light cut only, not attempting to break through. This gives the other operators lines to break to, speeding the work considerably and resulting in cuts with clean straight edges. The typical small cut measures approximately 2' x 3' or 2' x 4' with depth of 10 in. The broken pieces of concrete are about 18 to 24 in. square, some of them weighing as much as 150 lb.

A cut of average size is broken by the breaker crew in a few minutes. As soon as the pavement has been properly broken, the crewmen set up barricades, load jackhammers back on the compressor truck, climb aboard, and

Step 2—Jackhammers are used to break up the concrete. Average small patch is broken in a few minutes



Step 3—Truck-mounted Hydrocrane moves in to load out the broken concrete

Step 4—Two-man fine-grade crew follows up the crane, cleans and smooths the cut to prepare it for concrete pouring

Step 5—Transmit mixer pours concrete to within two or three inches of top. Next day asphalt is placed on top, finishing job. As many as 35 separate patches are concreted in a day

speed to the next location on the scout sheet.

When the breaker crew leaves location No. 1, the rough grade crew moves in immediately. Equipment for this crew includes a 2-ton Bucyrus-Erie Hydrocrane, mounted on an International KB-5 truck and equipped with a ¼-yd. hydraulic clamshell bucket, for loading out the broken pavement, and two Reo trucks with 5-yd. Daybrook dump bodies. The crew numbers 6 men, including two truck drivers, a crane operator and three helpers. This crew excavates the broken pavement, loading the material to the dump trucks which carry it away to various disposal spots in the district. In a matter of minutes the rough grading is completed and the crew gets on the move again, following the breaker crew.

Fine Grade Crew

Behind the rough grade crew comes the fine grade crew of 2 men, traveling in a truck. Their job, just as the crew name indicates, is to smooth out and clean up the cut in preparation for concrete pouring. Their equipment consists of hand tools: a shovel, a street broom, and a tamper. With these tools the two men prepare a clean level bed for the concrete.

Crew No. 4 arrives on the scene next. Equipment consists of a 5-yd. Jaeger transit mixer mounted on a Mack truck. One or two men, depending on the size of the cuts and the amount of concrete to be poured, accompany the truck. The crew members lay tar paper and spread concrete as deposited. Concrete is poured to within 2 to 3 in. of top of cut, leaving room for the asphalt which is placed a day later to complete the repair job. After the concrete is finished, this crew speeds on its way to the next location.

Bringing up the rear on the first day's work is the light-up crew, so called because just before four o'clock each working day this crew makes a quick circuit of all the patching jobs, hanging lanterns on the road blocks. During the rest of the day, however, this crew travels in the No. 5 position, right behind the concrete crew. The unit consists of a truck, a truck driver, and an additional man. In the truck the crew carries a supply of burlap for curing cover.

35 Jobs a Day

This routine, as described above, takes care of everything but the asphalt-placing, and is repeated from 23 to 35 times in an average 8-hour day. Simple division proves that each stop for each crew is of only a few minutes' duration, attesting the contractor's unusual mobility. Only by watching the various crews as they wheel up to a location, execute their specialty, and hurry on can one get a full appreciation of the speed and teamwork on which the procedure is based.

The asphalting, handled the day following, follows a similar pattern. A pick-up truck, carrying an additional man, follows the order of locations indicated on the previous day's scout list. These men trim the edges of cuts filled the day before and paint the edges with asphalt.

Next on the scene are two asphalt trucks and four men (2 rakers, 2 shovelers); then a truck-drawn trailer arrives carrying a 3-ton Buffalo-Springfield roller (10 tons if job is over 50 sq. yd.). When rolling is done, any road blocks, lanterns or other material still on the scene are loaded on the truck, the roller moves back on the trailer, and the road patch is complete.

New Plan Speeds Work

Except for one significant revision, the method here outlined is the same basic one which the McGuire and Rolfe firm has used on pavement patching work for many years. The important revision, made last January, resulted in great savings in time, labor, and other costs, however.

The revised step was the rough grading operation and the revision consisted of converting from hand labor to machine operation via the all-hydraulic truck crane (Hydrocrane). The maneuverability, mobility, working characteristics, and capacity of this machine proved to fit the needs, permitting handling in a single day something like twice the amount of work accomplished by the previous hand-labor method. Where the old method permitted covering only 25 to 35 miles per day on small cut jobs, the new has boosted mileage up to something between 50 and 85.

Saves $85 Daily

In addition, adoption of the new method eliminates two trucks and six men. Figuring truck costs at $25 per day each and total labor cost of six men at $35, the new grading method produces a daily saving of $85.

Here's how it works out:

(1) The compressor-breaker crew, ready-mix crew, and light-up crew are identical in both methods, and need not be considered.

(2) The hand-labor method, however, required two rough grade crews because one crew working with hand tools could not load the broken pavement fast enough to avoid slowing down the entire process too much.

(3) Two fine-grade crews were similarly required, one to follow up each rough-grade crew. The introduction of the truck crane sped up the rough grading so much that one crew could easily keep on the heels of the breakers.

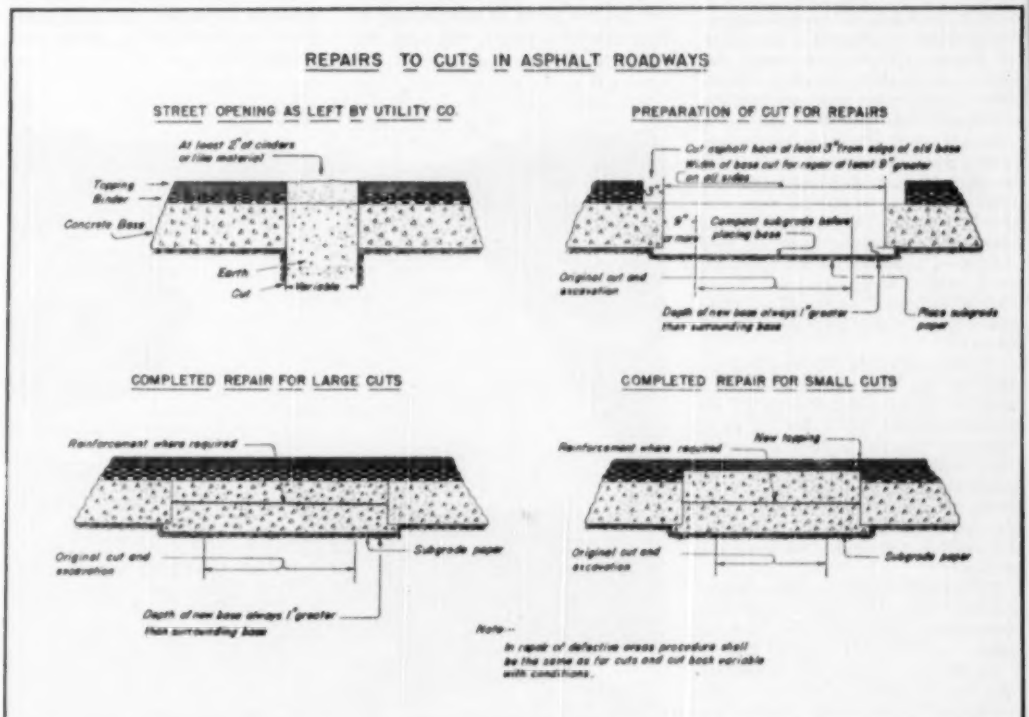
(4) The single crane grading crew required only four men and two 5-yd. dump trucks (plus the crane truck) whereas each of the two hand grading crews previously numbered four men and two 2½-yd. dump trucks.

Truck Crane Well Suited

Thus four men and one truck are eliminated in the rough grade crew alone. And, because there is now only one rough grade crew, only a single fine grade crew is required. Total saving, six men and two trucks.

★ Occasional excavations and grading jobs are also included in the contract. Here the crane loads away dirt which is piled up by a Bucyrus-Erie TD-14 bulldozer. This was a leveling job for a city parking lot

To make so much difference, a piece of equipment would have to be unusually suited to the work, and according to the McGuire & Rolfe organization, this is very much the case with the truck-mounted crane. The complete setup takes only seconds. The bucket operates under positive hydraulic power; buckets of this type can make a good-sized bite into the


REPAIRS TO CUTS IN ASPHALT ROADWAYS
STREET OPENING AS LEFT BY UTILITY CO.
At least 2" of cinders or like material
Topping
Binder
Concrete Base
Earth
Cut
Variable
PREPARATION OF CUT FOR REPAIRS
Cut asphalt back at least 3" from edge of old base
Width of base cut for repair at least 9" greater on all sides
3"
9" or more
Compact subgrade before placing base
Original cut and excavation
Depth of new base always 1" greater than surrounding base
Place subgrade paper
COMPLETED REPAIR FOR LARGE CUTS
Reinforcement where required
Original cut and excavation
Subgrade paper
Depth of new base always 1" greater than surrounding base
COMPLETED REPAIR FOR SMALL CUTS
New topping
Reinforcement where required
Original cut and excavation
Subgrade paper
Note—
In repair of defective areas procedure shall be the same as for cuts and cut back variable with conditions.

broken pavement on each pass, thus contributing to the overall speed of the operation.

The shift to machine handling of the rough grading was made at the start of McGuire and Rolfe's first 1949 contract for street patching in the District of Columbia, and the method was used throughout the year.

While most patches have been small, a few scattered locations required long continuous cuts plus such odd jobs as taking out curbs and simple dirt excavating. The long cuts often were 100 to 150 ft. long. The record for length is 5 ft. wide by 6,000 ft. long.

The depth for all cuts is about 10 in., which includes the distance down through the old base plus 2 to 3 in.

Two Types of Cuts

Cuts are of two general types—those resulting from utility and plumbing repairs, and those classed as breakdowns. Procedure on the former is as follows: The utility or plumber obtains a permit to cut the street at a designated point before digging. After the repairs are made, the utility or plumber backfills the cut and covers it with a temporary surface of cinders. A District of Columbia inspector checks the backfill and, finding it okay, issues an order for street repairs at this location. The repair work is done by the holder of the street patching contract and charged to the utility or plumber. He in turn passes the charge on to the customer. Breakdowns, on the other hand, are paid for entirely by the District.

The District, of course, has inspectors on hand to keep a constant check on all patches as they are made. The chief inspector on the job each day also turns over to the foreman of the contractor's pavement patching unit the list of locations for the following day's work. It is this list which forms the "Scout Sheet" on which the fast-paced McGuire and Rolfe procedure is based.

Upon reaching the McGuire & Rolfe office at the day's end, the foreman turns in the list given him by the inspector showing the following day's locations. This list is typed up at the office, with extra copies made for all concerned. Copies are then issued back to the foreman and, before operations get under way the following morning, he sees to it that each of his crews has a copy.

At the end of each day, the concrete foreman turns in a list of cuts concreted, also giving dimensions, and the amount and kind of material used.

On the basis of this list, the amount and kind of asphalt to be laid the following day is determined. Some of the cuts—on arterial roadways—require both hot-mix binder plus sheet asphalt surface. Ordinary cuts require the sheet asphalt only. Thus the concrete foreman's list serves as an accurate basis for determining the material needed by the asphalt crew the following day. When the amounts are figured, they are put on a blackboard in the plant foreman's office and the list is turned over to the asphalt foreman. He is held responsible for having the right amount of the right material at the right place at the right time on the following day.

This type of thorough preparation for each day's work reveals itself in the businesslike way each unit or team engaged in the pavement patching procedure goes its way. Minutes are hoarded, each man knows and does his job—there is plenty of hustle, little haste or waste.

McGuire and Rolfe's 30 years of experience has been an important factor in developing a well coordinated organization for handling such jobs. A. G. Rolfe is the company's president and treasurer; H. J. Rolfe is executive vice-president and manager.

Parallel Ditch Box Serves as Walk

The State road commission of West Virginia has provided travelers on State Route 16, near Beckley, facilities for two modes of transportation: they can ride or walk with equal assurance of safety.

Riding is on the new 40 ft. wide concrete highway (which will also be the bypass route for U. S. 21) around Beckley; walking is atop the 4'x6' concrete drainage structure which runs contiguous with the highway for almost a half mile. The top of this drainage structure has been finished as a 6 ft. concrete sidewalk, giving highway pedestrians a safe and reasonably comfortable place to walk.

At present, this unique drainage culvert is 2,000 ft. in length. It will soon be extended an additional 100 ft. under a railroad track embankment where it will juncture with another stream which runs clear of the highway right-of-way.

Illinois Arrests 30,968 in Truck Overloading

The Illinois state department of public safety during 1949 made 30,968 arrests in inspecting 617,290 trucks for overloads.

Developed to halt further damage to the state's highway system, the program has been carried out on a 24-hour basis through operation of 14 permanent and 30 portable scales. The state shortly will begin construction of 33 permanent weighing stations, according to Donald J. Walsh, director of the department.

Records show fines and costs collected on overloaded trucks during the period totaled $434,671. Many cases are pending.

★ Showing details of novel concrete ditch enclosure

"Research Pays Best Dividends"

Need for intensified research, with special attention to problem of low-cost local roads, told by Gen. J. A. Anderson of Virginia at Highway Research Board General Session; 29th annual meeting delegates hear some 80 papers, panel discussions and committee reports

THE small percentage of highways funds devoted to research pays the best dividends of all, noted Virginia highway commissioner General J. A. Anderson at the recent Highway Research Board meeting. Speaking as a keynoter at the 29th annual Board meeting, held December 11-16 in Washington, this vigorous and forthright speaker threw his prepared talk on the table and spoke from his long experience as a highway administrator. In simplest non-technical language he made several points of wide significance:

1. The Highway Research Board is the composite brain for technological planning. With four billion dollars a year likely to be spent for highways in the period ahead, we must use a small fraction for research to tell us how to invest the larger fraction more wisely. The small percent spent for research pays best of any part of the highway cost.

2. While we must consider the whole problem of the road system, the biggest need, in General Anderson's belief, is for a "mudless, dustless, light-traffic road at $3,000 per mile." While admitting the pressing problems of the arterials, he reminded that we as highway engineers are dependent on grass-roots support for our road programs. The highway "have nots" living out in local communities are the people who will retard road building if we don't give them attention.

3. Factors beyond highway engineering bear heavily on highway development. These factors include public attitudes, legal questions, and the career outlook for highway engineers, and of course, financing. Particularly serious today is the problem of personnel, centering in the need to provide reasonable salaries and security for attracting young engineers into a highway career. Beyond all other things is the need to keep the public fully advised on road problems including the needs of the highway department.

Wide Range of Papers

As usual it would be difficult to lift out any one paper or subject to feature in a summary of the four-day meeting. Growing emphasis continues to be given to traffic and safety phases of highway work, as evidenced by several papers or reports: "Accident Analysis for Program Planning," by Roy E. Jorgensen and Robert G. Mitchell, Connecticut state highway department; "Report of Committee on Night Visibility," by Burton W. Marsh, of American Automobile Association; a report of glass bead and reflectorized paint study by V. H. Lyon and D. L. Robinson of Missouri; other papers not mentioned here; and an entire evening meeting devoted to night visibility.

Following are notes and excerpts on selected subjects:

Safety vs. roadside development was given prominent attention on the program, as was in fact the whole subject of traffic.

Surface Properties. Importance of recognizing the various properties of a highway surface were discussed in a committee report on anti-skid properties (R. A. Moyer, chairman), read by T. E. Shelburne of Virginia. Six properties, including skid resistance, tire wear, visibility, glare, smoothness, and noise, must be provided in balance. The public judges a road by

Kernels from the Research Meeting

Research needn't all be formal. Research-type thinking can go on every day.

* * *

There's not enough investigation of the case-history type, everyone being so engrossed in getting on with new work.

* * *

Better tie-up between state highway department and engineering colleges needed in many states. Encourages postgraduate highway engineering study; sets stage for better job of applied and fundamental research; fosters closer teamwork and greater interest in highway careers; vitalizes teaching.

* * *

What price architectural embellishments on expressways, such as curved wingwalls, fancy work along the decks, etc.?

* * *

How much compaction in deep-frost states?

* * *

The "in-between" urban projects, meaning arterial streets and expressways at grade, need more attention in the scheme. Most cities cannot afford full-dress limited-access construction.

* * *

28% of all road construction dollars go for excavation.

* * *

New idea to watch: powdered rubber admixture in black top for greater durability and better serviceability.

E. B. Bail, well-known yarn teller and materials engineer, New Mexico, while attending the "outer lobby" session, tells the one about the road project up in Colorado. It seems that a lot of heavy equipment was single-filing through a cut, getting out the yardage fast, when one of the tractor operators had to leave his machine suddenly on a rather urgent mission. On his return he found all the other machines lined up waiting to pass. A bright young inspector figured out that the stoppage had cost the contractor $130 including lost yardage, overhead, equipment amortization, etc. "Why not pay $20 a day and have a stand-by operator?" he suggested to the contractor, who did same and saved $8,000 on rest of job. (This story sounds vaguely familiar. Ed.)

Research Board Awards

F. N. Hveem and R. M. Carmany of the California division of highways received the Highway Research Board Award for a paper of outstanding merit given at the 28th Annual Meeting of the Highway Research Board in December, 1948, entitled "The Factors Underlying the Rational Design of Pavements."

The Highway Research Board Distinguished Service Award, established for outstanding achievement in the field of highway research, was presented to Professor Kenneth B. Woods and O. K. Normann in a ceremony at the 29th annual meeting.

Professor Woods has made notable contributions to the advancement of the technology of highway transportation. As the executive officer of a new type of research institution his work has brought him wide-spread recognition and an enviable reputation among co-workers. His present position is Professor of Highway Engineering, Purdue University, and Associate Director of the Indiana Joint Highway Research Project, a cooperative project between Purdue and the state highway commission, and his contributions to the technical literature are many and important.

Mr. Normann for the past 14 years has been engaged in research relating to the use and operation of Highways. Now Chief of the Section of Traffic Operations at Purdue he has been responsible for the analysis of research data on traffic operation studies conducted by the Bureau of Public Roads. Since 1945 Mr. Normann has served as chairman of the Board's Highway Capacity Committee which has made several special studies and recently published a comprehensive report entitled "Highway Capacity — Practical Applications of Research."

its smooth-riding quality, and highway engineers can afford to study smoothness as an index to public acceptance of their work, and also as an index of roadbed failure. A rating system for the six properties was suggested, to be applied to each section of road.

The tremendous importance of the non-skid quality was emphasized in this report, which noted that the coefficient of friction for all types of surfaces dwindles rapidly as traffic speed mounts. The coefficient is between .2 and .3 at 30 mph. regardless of tires. The seriousness of this fundamental fact is seen in its relation to another fact: friction requirements for braking go up approximately as the square of the speed.

Slipperiness Serious

A slippery road is a sign of failure in design or upkeep. The skidding problem is being accentuated by several factors, including the faster road speeds of today, the growing mileage of black-top resurfacing and seals (with frequent oversealing and excessive use of asphalt), lack of testing and control prior to and during sealing, and lack of testing and research on the whole subject by the various highway departments. This committee—which it is suggested be renamed to cover all surface characteristics instead of merely skid prevention—recommends that all design and maintenance work be related to either stopping tests or to coefficient of friction measurements.

One example of the safety value of closer control of the surface texture was given, this being a Virginia road which had a stopping distance of 200 ft. prior to correction, and 94 ft. afterward. California test apparatus designed for calibrating a highway for braking effectiveness was described, this machine being part of a large-scale investigation.

Roughness Index Emphasized

New emphasis on roughness index measurement and analysis of new surfaces is shown today. Seven states have adopted a new improved roughometer developed by Public Roads, which permits a study of the types of unevenness, such as joint drop-offs, waviness, etc. California studies recently revealed a new "world record" in new-pavement smoothness, a p.c. concrete pavement on U.S. 40 recording only 56 in. per mile R.I., compared to 100 excellent and 80 seldom achieved. A dense-graded plant-mixed asphaltic concrete project measured 72 in. per mile R.I., also a remarkable figure some 50% below usual good results; 92 for the best recent open-graded hot-mix job, and 92 for the best chip-covered sealing job, also unusual.

These figures compare with a customary 175 in roughness index for city street plant-mix work, and as high as 415 or more for street re-eleveling.

Machinery Job Performance

Construction Equipment Performance. The committee on the economics of highway construction and maintenance met and reviewed the work of the Production Cost Unit of BPR. Under Fred Farrell, its head, this group working in conjunction with the research committee gathered a great mass of stop-watch data from road jobs during the past year. Fifteen reports have been issued [Many published by ROADS AND STREETS in recent months]. Trainees entering Public Roads are assigned to this project in rotating groups, getting a valuable appreciation of construction problems as part of their indoctrination.

The studies are to be continued, and effort will be made to dig more deeply into on-the-job equipment management factors. Contractors have shown enthusiasm for the reports, but some have considered the data too general to be of fullest value. The committee, according to Farrell and H. J. Kirk of AGC, its chairman, is admittedly feeling its way and the intention is to both broaden and deepen the investigation. Maintenance work offers a rich field for equipment-management study, motor grader operation, for example, today varying in unit cost from $10 to $90 per mile in one case study. Over 42,000 graders today are assigned to a tremendous operation taking in a million miles of little improved local roads.

Maintenance Cost Report

Maintenance Costs. This committee, H. A. Radzikowski, chairman, included much specific data in its report. A few of the facts and figures:

1. Arterial highway maintenance in 1949 averaged $784 per mile per year, up 80% since 1940.

2. Costs rose slightly during the year, with leveling off shown. Maintenance costs rose more slowly during and since the war than construction costs, due to inflexibility of salaries and wages; recent over-due raises for maintenance employees were a factor in holding maintenance to its peak while construction costs dropped during 1949.

3. While unit costs rose only 89% since 1935, total maintenance expenditures for the nation's highways rose 125%. Causes: roads getting older, traffic getting heavier, more services demanded. The 1948 total $1,170,000; 1949 somewhat higher. State highway maintenance rose 152% to $461 million from '36 to '48; county and local road maintenance, 112%; city and village street, 107%.

4. About 47% of road upkeep cost is for labor, indicating need for further mechanization.

5. Maintenance costs per traffic vehicle rose from 2.3 miles in 1936 to 2.9 in 1948, as a national average.

(*Continued on page* 61)

Proper Sizing of Excavator vs. Hauling Equipment

(First of two articles)

This discussion suggests how to select the proper sized excavating equipment for use in conjunction with hauling equipment for most economical operation. Presented by permission from copyrighted Technical Bulletin No. 3, published by the Power Crane and Shovel Association. This issue: Selecting Correct Excavator Capacity. Next month: Sizing the Hauling Units, and Fleet Synchronization

YOUR excavator and hauling units must be regarded in combination as one basic unit of production, synchronized for maximum output. This discussion deals with all three factors involved: 1. Sizing of the excavator; 2. Sizing of the hauling equipment; 3. Synchronization of the hauling fleet to obtain minimum delay and maximum production.

Importance of Sizing

The correct size of excavator is obviously the first step of the problem. Physical conditions on the job enter directly into the size determination. Also, hauling units sizes cannot be determined on an efficiency basis until the excavator size is known.

The problem of synchronization naturally falls into third position. Its correct analysis depends upon size of excavator and size of hauling units.

"Proper Sizing of Excavating and Hauling Equipment," Technical Bulletin No. 3, has been prepared by the members of the Power Crane and Shovel Association with the cooperation of hauling equipment manufacturers. Third of a series on the operation and maintenance of excavating equipment. Copies may be obtained by excavator owners, without charge, from local distributors or from manufacturer members of the Association. Or, they may be obtained for 50c per copy by writing to The Power Crane and Shovel Association, 74 Trinity Place, New York 6, New York.

In practice there is a tendency to undertake new jobs with equipment inventory on hand. In many cases, this is poor economics. Every new job, if it departs from the pattern for which the original equipment inventory was built, should be analyzed carefully to determine the most efficient combination of excavator and hauling equipment required for the job. When this ideal setup is determined, a careful analysis should be made, comparing the additional profit available using new equipment with the cost of setting up this combination of machines for handling the job at lowest cost.

Almost all contractors attempt to select jobs which can be most efficiently handled by their equipment inventory. Frequently, however, this policy can be only partially applied. In such cases, the penalty to profit possibilities should be analyzed carefully.

Sizing the excavator is of major importance because:

1. There is a wide variation of basic cost-per-yard for loading between the smallest and the largest excavator considered here (¾ to 2½ yd.), depending on material worked.

2. There is a difference of about 100%, within this size group, in the depth of bank which can be loaded with greatest efficiency.

3. Sizing the equipment to permit minimum swing materially affects production; increase in output between a short swing and a long swing can be as much as 75%.

4. Job clearance conditions and pit dimensions may present limitations that bar certain sizes of equipment or seriously curtail their operation.

5. On-job or job-to-job moving may be so extensive as to present a factor favoring smaller machines.

6. Proper sizing may permit a more efficient balance of haul cycles to utilize hauling equipment more effectively.

7. Volume of work to be handled, together with anticipated future availability of similar work, should be considered in making additional equipment investments.

8. Equipment combinations must come within limitations of ability to finance economically.

An excavating operation should be regarded as a problem of teamwork. Size and timing must be studied carefully and the most favorable combination set up within limitations of job and available equipment. Frequently, makeshift combinations are more costly on a single job than the net cost of new equipment required to build up the proper combination for handling the job efficiently and at lowest net-cost-per-yard.

Any major project should be figured on the basis of ideal equipment combinations, then refigured with use of available equipment. If a material dif-

ference is shown, a detailed analysis should be worked out to develop a plan for the use of the most suitable equipment for maximum profit.

I. Selecting Correct Excavator Capacity

Shovel Sizing

In determining the most effective size of excavators, these factors are discussed in detail. 1. Types of Material. 2. Depth of Bank. 3. Angle of Swing. 4. Clearances Involved. 5. Moving Requirements. 6. Balancing Haul Cycles. 7. Volume of Work Available. 8. Financing Problems. The order of importance will vary on different jobs, depending on local conditions.

1. Type of Material. For digging hard materials, the increased power, large dipper opening, and heavy construction of large excavators presents a great advantage. Conversely, in easy digging, low investment, ready mobility and close clearances of small machines are important advantages. See Table 1.

Output shown must be adjusted to job conditions and materials and then analyzed on the basis of cost of operation before correct size for an individual project can be determined.

2. Depth of Bank. The deeper the cuts to be worked, the greater the importance of studying possible advantages of larger shovels. In very shallow cuts, the difficulty in getting a full dipper plus frequent move-ups may give smaller shovels an actual advantage in lower cost-per-yard . . . sometimes even a larger output-per-hour. See Table 2.

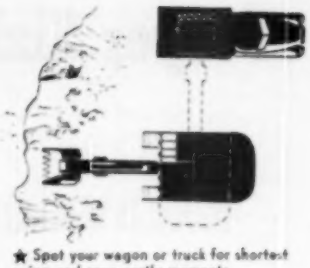
Reach is not entirely determined by length of boom and handle, as boom foot and shipper shaft location plus shape of dipper also affect the working range.

Where material is to be loaded on top of a bank, maximum dumping height of shovel also must be compared with the combined height of bank and hauling units into which material must be loaded.

In addition to considering maximum depth of bank in which shovel will work, the depth of cut at which the shovel will operate with *maximum efficiency* also should be considered.

Optimum depth of cut may be defined as that depth of cut which produces the greatest output and at which the dipper comes up with a full load without undue crowding. The optimum depth of cut does not represent and has nothing to do with the maximum digging range of the machine.

These optimum depths of bank in which the dipper will fill without undue crowding are shown in Table 3.



★ Spot your wagon or truck for shortest swing and save costly moments

Since it requires 8.4 ft. of bank in free flowing material to fill a 2½-yd. dipper, somewhat greater relative efficiency in shallower banks is obtained with smaller shovels.

Depth beyond the optimum is not a sizing factor. Cuts can be taken out in several levels to get maximum efficiency for the size excavator applied.

3. Angle of Swing. Reach and clearance of the excavator sometimes may affect the angle of swing at which hauling equipment can be loaded. The importance of this factor is readily apparent. A saving of 30° angle in swing cycle may increase production of a shovel 15 to 20%, of a dragline, around 10%.

Table 3—Optimum Depth of Shovel Cut

Size Dipper	Light, free flowing materials like loam, sand, gravel	Medium materials such as good "common" earth	Harder materials such as rough and hard or wet, sticky clay
⅜	3.8'	4.5	6.0
½	4.6'	5.7	7.0
⅝	5.3'	6.8	8.0
1	6.0'	7.8	9.0
1¼	6.6'	8.8	9.8
1½	7.0'	9.2	10.7
1⅝	7.4'	9.7	11.5
2	7.8'	10.2	12.2
2½	8.4'	11.2	13.3

Table 8, showing swing and depth of cut factors, also should be considered in the angle of swing problem. Working range of the excavator has some effect on planning of work for minimum swing angle. The wider the dumping range, the easier it is to arrange loading from a short swing angle. However, work usually can be planned to secure efficient short swings regardless of excavator size.

4. Clearances Involved. Certain types of work involve excavation, or moving in close quarters, where the smaller shovel has an advantage. Basement excavation, operation in city streets open to traffic, in alleys, around industrial plants, under overhead wires, or in tunnels are typical jobs where small size may have definite advantages.

Manufacturer's specifications should be consulted for exact clearance data. Working in tight quarters is not efficient from a production standpoint. If much close-quarter work is in sight, it is advisable to keep size down to where machine can operate comfortably within minimum work radius.

On work around buildings, walls or other obstructions, rear-end clearances becomes a factor. Some ⅝-yd. machines have rear-end clearance as low as 5½ ft. Rear-end clearance goes

Table 1—Power Shovel Hourly Output in Cubic Yards

Table from Technical Bulletin No. 1, Power Crane and Shovel Association; approximate production figures in various materials, based upon optimum depth of cut, 90° swing and grade level loading.

Class of Material	⅜	½	⅝	1	1¼	1½	1¾	2	2½
Moist Loam; Light Sandy Clay	85	115	165	205	250	285	320	355	405
Sand and Gravel	80	110	155	200	230	270	300	330	390
Good Common Earth	70	95	135	175	210	240	270	300	350
Clay, Hard, Tough	60	75	110	145	180	210	235	265	310
Rock, Well Blasted	40	60	95	125	155	180	205	230	275
Common, with Rocks and Roots	30	50	80	105	130	155	180	200	245
Clay, Wet and Sticky	25	40	70	95	120	145	165	185	230
Rock, Poorly Blasted	15	25	50	75	95	115	140	160	195

Table 2—Maximum Shovel Reach

Manufacturer's sizes of power shovels with standard boom and dipper handle lengths, showing maximum cutting length and reach with boom at 45°.

Size Dipper	Length Std. Boom	Length Std. Handle	Maximum Cutting Height	Maximum Cutting Radius
⅜	15' to 15'	11' to 13'	17' to 19'	to 22'
½	15' to 16'	12' to 13'	19' to 24'	21' to 24'
⅝	17' to 18'	13' to 15'	21' to 27'	25' to 28'
1	20'	14'	23' to 27'	31' to 32'
1¼	21'	16'	23' to 27'	31' to 32'
1½	21' to 23'	16' to 18'	24' to 29'	32' to 33'
1⅝	22' to 24'	16' to 18'	26' to 30'	32' to 33'
2	22' to 25'	17' to 19'	26' to 30'	33' to 36'
2½	25' to 26'	18' to 19'	28' to 35'	35' to 38'

★ Draglines too need a well matched team of hauling units and thought given to hauling conditions

★ A truck or wagon always "coming up"—keep this aim constantly in mind for maximum $ $

up around 1 to 2 ft. per size to as high as 15 ft. on some of the 2½-yd. machines.

There is not so much difference in height clearances. These range as low as 9¼ ft. on ⅝ and ¾ yd. machines to around 12 to 17 ft. on 1⅛ to 2½-yd. units with standard A-frame and with boom lowered. Clearance height is especially important where machines are expected to work and travel under overhead structures and wires, particularly those carrying electric power which may be a hazard to employees.

12 ft. clearance width for standard crawlers, and even wider when extra width shoes are used.

Shipping clearance height on ⅝ and ¾ yd. machines runs 9½ to 10½ ft. . . . larger machines to about 17 ft. with boom lowered, or to about 13½ ft. with "A" frame removed or lowered to cab height. Add platform height of trailer to obtain travel clearance.

Working weight is another factor to be considered in connection with frequent job-to-job moves. ⅝ yd. machines weigh 8½ to 12 tons; ¾ yd. units 11½ to 14 tons; ¾ yd. machines 17 to 22 tons; 1½ yd. between 70 to 80 tons.

Table 4—Effect of Depth of Cut and Angle of Swing on Power Shovel Output

Depth of Cut in % of Optimum	ANGLE OF SWING IN DEGREES 45°	60°	75°	90°	120°	150°	180°
40	.93	.89	.85	.80	.72	.65	.59
60	1.10	1.02	.96	.91	.81	.73	.66
80	1.22	1.12	1.04	.98	.86	.77	.69
100	1.26	1.16	1.07	1.00	.88	.79	.71
120	1.20	1.11	1.03	.97	.86	.77	.70
140	1.12	1.04	.97	.91	.81	.73	.66
160	1.03	.96	.90	.85	.75	.67	.62

Conversion factors which when applied to the output at 90° swing and optimum depth of cut will give the output at other angles of swing or depth of cut.

5. Moving Requirements. When considerable on-job moving is required, travel speeds and mobility should be considered. These are important where machines are used for pick-up work around a yard, mine, or in finishing and cleanup on a road job.

Rubber-tire mounted units are available in the smaller sizes for high-speed mobility.

Frequent job-to-job moves involve questions of clearance, both width and height. Permits usually are required for moving units over 8 ft. in width. ⅝ and ¾ yd. machines, designed for basement, driveway and similar transit-type work usually meet the 8 ft. clearance. Larger machines go up to

6. Balancing Haul Cycles. Problems involved in sizing and synchronizing the haul fleet, to keep an excavator steadily at maximum production for lowest overall cost-per-yard, are discussed later in this summary. As conditions on various sections of any excavating job vary with change of bank, materials and length of haul, the right combination for today's work on one section of the job may not fit tomorrow's conditions.

It is, therefore, advisable to study the economy of applying two or more small excavators in place of a single large excavator even though the large excavator, from the standpoint of loading costs alone, shows lowest cost-per-yard.

With two or more units of operation, work can be planned so that haul cycles will be balanced to utilize the haul fleet effectively at all times. For instance, with one excavator on long-haul work and the other on short-haul, the hauling fleet can be divided, most units serving the long haul. If the same sections are worked with a single excavator, either the long-haul section will be worked short, or more haul equipment must be rented. When the excavator comes to the short-haul work, most of the haul fleet will stand idle.

7. Work Available. Regardless of the economy of a new and modern excavator, tailored to the correct size for current work, sufficient work must be in sight to pay off the capital investment. And, good prospects for future work (or resale) must be available to convert the investment into profits and return of capital for future replacement equipment.

Depreciation is a reasonable allowance for the exhaustion, wear and tear of property used in trade or business; including a reasonable allowance for obsolescence. The average "useful life" of excavators is given in Table 5, listed in years—based on 2000 operating hours per year. Lifting cranes are listed separately as not being necessarily related to shovels by size in cubic yards.

After the delivered cost of the contemplated machine and its attachments is established, the volume of work definitely available, together with a safe forecast of future work on the basis of annual estimated output must be analyzed.

Table 5—"Useful" Excavator Life

	⅝ to ¾ Cu. Yd.	1 to 1½ Cu. Yd.	2 Cu. Yd. and Over
Shovels and Hoes	5 years or 20% yearly	6 years or 16.67% yearly	8 years or 12.5% yearly
Draglines and Clamshells	5 years or 20% yearly	9 years or 11.11% yearly	12 years or 8.33% yearly
	2½ to 5 Tons	10 to 15 Tons	20 Tons and Over
Cranes	5 years or 20% yearly	9 years or 11.11% yearly	12 years or 8.33% yearly

NOTE: Consult Technical Bulletin No. 2, Chapter 1, [See Sept. '49 Roads and Streets] for more detailed information on depreciation and fixed costs.

Table 6—Typical Shovel Output Table

	Per Hour	Shift 8 hours	Week 40 hours	Year 2000 hours
⅝ Yard	42	336	1,680	84,000
¾ Yard	63	504	2,520	126,000
⅞ Yard	92	736	3,680	184,000
1 Yard	122	976	4,880	244,000
1¼ Yard	151	1,208	6,040	302,000
1½ Yard	176	1,408	7,040	352,000
1⅝ Yard	197	1,576	7,880	394,000
2 Yard	223	1,784	8,920	446,000
2½ Yard	260	2,080	10,400	520,000

Based on hard tough clay as average digging and an operating efficiency of 84% (average 10 minute delay per hour).

Table 7—Short-Boom Dragline Performance in Cu. Yds.

CLASS OF MATERIAL	⅜	½	⅝	1	1¼	1½	1¾	2	2½
Light Moist Clay	5.0′	5.5′	6.0′	6.6′	7.0′	7.4′	7.7′	8.0′	8.5′
or Loam	70	95	120	160	195	220	245	262	305
Sand or	5.0′	5.5′	6.0′	6.6′	7.0′	7.4′	7.7′	8.0′	8.5′
Gravel	65	90	125	155	185	210	225	255	295
Good Common	6.0′	6.7′	7.4′	8.0′	8.5′	9.0′	9.5′	9.9′	10.5′
Earth	55	75	105	135	165	190	210	230	265
Clay, Hard,	7.5′	8.0′	8.7′	9.3′	10.0′	10.7′	11.3′	11.8′	12.3′
Tough	35	55	90	110	135	160	180	195	230
Clay, Wet,	7.3′	8.0′	8.7′	9.3′	10.0′	10.7′	11.3′	11.8′	12.8′
Sticky	20	30	55	75	95	115	130	145	175

Note: Top figure denotes optimum depth of cut. Bottom figure denotes yards per hour.

Table 8—Effect of Depth of Cut and Angle of Swing on Power Dragline Output

Depth of Cut in % of Optimum	ANGLE OF SWING IN DEGREES 30°	45°	60°	75°	90°	120°	150°	180°
20	1.06	.99	.94	.90	.87	.81	.75	.70
40	1.17	1.08	1.02	.97	.93	.85	.78	.72
60	1.24	1.13	1.06	1.01	.97	.88	.80	.74
80	1.29	1.17	1.09	1.04	.99	.90	.82	.76
100	1.32	1.19	1.11	1.05	1.00	.91	.83	.77
120	1.29	1.17	1.09	1.03	.985	.90	.82	.76
140	1.25	1.14	1.06	1.00	.96	.88	.81	.75
160	1.20	1.10	1.02	.97	.93	.85	.79	.73
180	1.15	1.05	.98	.94	.90	.82	.76	.71
200	1.10	1.00	.94	.90	.87	.79	.73	.69

Conversion factors which when applied to the output at 90° swing and optimum depth of cut, will give the output at other angles of swing or depth of cut.

The hours per year will vary, of course, with weather conditions, operating season, and special conditions of application.

Taking previous table of production without delays and converting for an operation with excellent management and job conditions (84% efficiency), digging material that will average out on production equivalent to hard tough clay (probably what most people would call medium digging), table 6 is computed showing hour, shift, week and annual (2000 hr.) production for various sizes of shovels.

Note that *no* allowance is made here for on-job or off-job moving, weather, or other delays. Table 6 covers continuous production at high efficiency.

In selecting a suitable size to handle desired annual production, a study should be made of actual job materials and efficiency percentages plus any special altitude and weather problems involved. Tables as worked out here are merely for comparison . . . should never be used for actual job estimating.

With a carefully estimated output figure for excavator sizes, information given here will help analyze expected production for other sizes to be considered. Comparative costs and profits can be figured to determine the most economical size. This must then be checked against the limiting factors, which are materials, working ranges, clearances, moving problems, and financing to arrive at the final answer.

Local distributors will be glad to furnish manufacturer's specifications on machines to be considered.

8. Financing Problems. Excavator size must be relative to the financial resources of the buyer. However, when a careful analysis of the cost factors and extra profits involved is made, and sufficient work is definitely in sight, an experienced contractor can usually finance the right equipment up to a reasonable percentage of his cost.

Dragline Sizing

The previous discussion of shovel size applies in general to excavators with other attachments. The following supplementary comments on draglines may be helpful.

Most draglines work is overcasting, although present day large-top hauling equipment has greatly increased the use of the dragline as a loading tool.

In soft materials, extra wide, extra long, or extra long and wide, crawlers are generally used to increase flotation.

Bucket size and boom length for dragline work are more variable relative to the basic machinery unit than are dipper sizes and shovel front end equipment. Shovels usually work with the standard dipper though occasionally special oversize dippers are used for snow, cinders, ashes, coal or other extremely light materials. Also, for overcasting in coal stripping, some of the large shovels sometimes are equipped with extra long booms and smaller-than-standard dippers.

When standard dragline booms are extended to secure needed digging and dumping ranges, this may call for reducing bucket size to come within the machine's stability rating. There is also a variation in bucket capacity due to application of buckets of various weights for handling different types of materials. Hard digging or abrasive materials may require a heavy bucket. Then, a smaller yardage capacity must follow.

Dragline buckets are available in light, medium and heavy duty types. The lightest bucket which will handle your material successfully is preferable. This is true even when the lighter bucket does not permit increasing the bucket capacity. The lighter the load carried in the combination of bucket weight plus material, the faster the cycle of operation.

In selecting bucket and boom length, water content and suction of material in the bank must be considered as well as the actual weight of material.

As the bucket is lifted from the cut, wet clay and saturated muck may give overload factors not covered in tables showing weight of materials.

Loading a dragline down with the largest possible bucket it will carry at a given boom length is not smart production strategy. Resulting overloads not only make for high maintenance but slow down the cycle. Frequently, production is lost rather than gained. Plenty of power for a snappy cycle behind the front-end combination selected is most desirable.

Owners sometimes tend to ignore manufacturers' ratings and overbucket their dragline, figuring it is economical to "put on all the load she will carry."

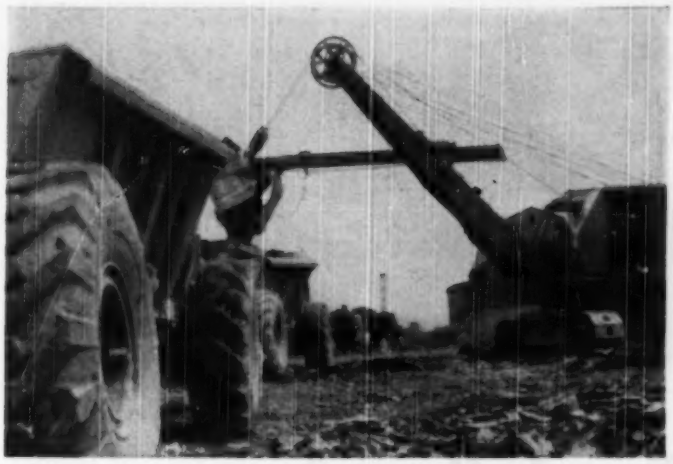
Be sure to study cycle time and the heap height carefully in tests with over-size bucket equipment. Operators will naturally be prejudiced, favoring larger buckets and slower cycles. Only actual pay yards moved per hour can give the correct answers to the problem.

1. Type of Material. Here, as with shovels, the harder the material, the greater the advantage of the larger excavator. Difference in cost-per-yard is reduced in easy digging. Also, target area involved in loading to haul equipment, is a factor to consider as well as lower investment and readier mobility of the smaller machines.

Table 7 gives typical dragline production for various types of material on a theoretical 60-min. hour, loading to hauling equipment, based upon optimum depth of cut, 90° swing and grade level loading. It also shows the most desirable, or optimum, depth of cut. (Tables 5 and 8 also should be considered.)

Table 9—Crane Boom Lengths Offered as Standard Equipment

Standard Machine Size with Bucket Size Shown	⅜	½	⅝	1	1¼	1½	2	2½
⅜ Yd.	25′ to 35′							
½ Yd.		30′ to 40′						
⅝ Yd.			35′ to 50′					
1 Yd.				40′ to 55′				
1¼ Yd.					45′ to 60′			
1½ Yd.						50′ to 70′		
2 Yd.							50′ to 90′	
2½ Yd.								60′ to 100′



★ Wagon capacity 12 to 13 yd., shovel dipper 1½ to 2 yd.—a common ratio today

2. Weight of Material. In studying size for dragline or clamshell operation, special consideration must be given to weights of material. The following table gives approximate weights of average materials, per cubic yard of excavated material.

Earth, Moist	2400 lb.	Loose stone	2700 lb.
Sand, dry	2700 lb.	Clay, wet	3000 lb.
Sand, wet	3200 lb.	Coal	1350 lb.
Gravel	2900 lb.	Cinders	1100 lb.
		Ashes	900 lb.

These approximate weights should be checked with actual weights and allowances made for possible overloading in figuring bucket applications.

3. Working Ranges. Several boom lengths and counterweights plus various weights of buckets change working ranges and capacity of dragline and clamshell machines extensively. Nominal dragline working range also is increased by the throw of the bucket which will be from ⅛ to ½ the dumping height, depending on the skill of the operator. This extends both the digging and dumping range for overcasting, but does not affect the dumping range when loading to hauling equipment. Boom angles less than 35° from horizontal are seldom advisable for dragline work.

4. Bearing Pressure. This factor is very important in dragline operation. Ground bearing pressure per square inch for draglines ranges from about 5 psi. with extra long, extra wide crawlers to 10 psi. or more for some of the larger machines on standard crawlers.

In comparing crawler mounting specifications, ground bearing pressure per square inch, rather than square feet of bearing area is, of course, the determining factor. Actual working weight of dragline with attachments should be used in making the analysis.

Clamshell. Sizing of clamshell is usually governed by production capacity and clearance height desired. Rear-end radius is sometimes a factor. Conditions are so variable on clamshell operation that a table showing typical production has little value.

Hoe. On hoe production capacity, digging depth and clearances are important factors. Wide variations in operating conditions make any general table impractical. Hoes are available up to approximately 2 cu. yd. capacity. In the smaller sizes, cutting width rather than the capacity of the bucket is often the prime consideration. The hoe has been known by a variety of names. These include draghoe, trench hoe, drag shovel, and pull shovel.

Next month: Sizing the Hauling Units, and Fleet Synchronization.

Concrete Pavement Design Trends Summarized

Latest thinking of the 48 state highway departments and the District of Columbia on concrete pavement practices is presented in a report of the American Road Builders' Association committee on concrete pavement design. Issued as ARBA Technical Bulletin Number 163, the 122-page booklet has been compiled with the assistance of representatives from each of the Highway Departments and covers subgrade soil practices, concrete materials, proportioning, placing, finishing and curing, as well as structural features of concrete pavements.

Heading the committee was A. T. Goldbeck, engineering director, National Crushed Stone Association, Washington, D. C., and members were: T. J. Kauer, director of highways, Ohio Department of Highways, Columbus, Ohio; Tilton E. Shelburne, director of research, Highway Research Council, University of Virginia, Charlottesville, Va.; E. W. Bauman, secretary, National Slag Association, Washington, D. C.; and H. F. Clemmer, engineer of materials, District of Columbia.

A revision of ARBA Technical Bulletin No. 121, the new booklet, available to all ARBA members on request and sold to others at $1 per copy, represents an extensive study by the committee, a member of which personally supervised each subject. It also contains comments by committee members on the trends revealed by the tabulated results. Address American Road Builders Assn., International Bldg., Washington 4, D. C.

Manual of Truck and Trailer Restrictions

The 1950 edition of The FWD "Truck & Trailer Size & Weight Restrictions" booklet has been published for free distribution by The Four Wheel Drive Auto Company.

This popular, pocket-size publication, originated in 1933, lists all laws affecting the size and weight of trucks, trailers and truck-trailer combinations for every state.

More than 100,000 copies of previous editions have been distributed. Free copies of the "Truck & Trailer Size & Weight Restrictions" booklet may be obtained by writing the Sales Promotion Department of The Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Clearing House Section Outstanding Used Equipment Values

Over one hundred fifty individual advertisers feature an exceptionally large selection of used equipment in the 10-page "Clearing House" section which starts in this issue on page 106. Readers will find the "Clearing House" a dependable and informative directory of outstanding values in used equipment and we suggest that you make perusal of these pages a regular habit each month. At any time that you have equipment you wish to sell, anywhere in the country, we suggest that you present your offerings in our "Clearing House." This section is growing faster, getting larger every month because it's doing a better, quicker selling job—at one low cost!

★ When does a mountain road location justify a separate truck lane? How long a continuous grade permissible?

Uphill Truck Speeds

Surveyed by Arizona Highway Engineers

By Wm. E. Willey

Engineer, Economics and Statistics,
Arizona Highway Department
Phoenix, Arizona

Valuable new data on relation between heavy vehicle speeds and length and steepness of mountain grades, obtained in survey

THE division of economics and statistics of the Arizona highway department recently completed the field survey of one phase of a study of the performance of heavily loaded motor vehicles on various mountain grades. This survey was conducted at the suggestion of the U.S. Bureau of Public Roads and the Design Division of the Arizona Highway Department.

The object was to determine the actual speeds of trucks on uphill mountain grades, in order to assist the department's engineering division in the following:

(1) Location of new highways, by determining how far a heavy truck will travel up various rates of grade before the crawl speed will be reached.

(2) Determination of when an outside truck lane is justified on new work, as well as indicating the need for providing a truck lane on existing mountain grades.

In addition, the study provides comparative data desired by the BPR in connection with other truck studies.

In this report, the term "truck" denotes a single unit truck or any of the truck and trailer or semi-trailer combinations encountered in the survey. Arizona's laws, relating to gross length of 65 ft., practically prohibit the use of the longer combinations sometimes encountered on the highways in other areas. As it is, gross weights from 90,000 to 100,000 lb. are not uncommon.

Due to budgetary limitations, the survey was not as broad as it could have been. However, it is believed that the data presented here will be of benefit to locating and design engineers, as well as to manufacturers and operators of commercial vehicles.

★ Loadometer checks were made in conjunction with speed observations and also correlated with the truck's rated hp.

Buses and house trailers were not included in the study. It was found that new postwar buses in use traveled at much higher speeds than previously estimated. With faster schedules, and because most buses carry mail, it was decided not to cause the delay of weighing.

I—The Basic Graphs

Speed profiles for the various test sections were plotted as shown in Fig. 1. There were ten such profile sheets. The following procedure was used: After applying any necessary speed correction factors, and computing the weight horse power ratio, the trucks were then grouped in the following classes:

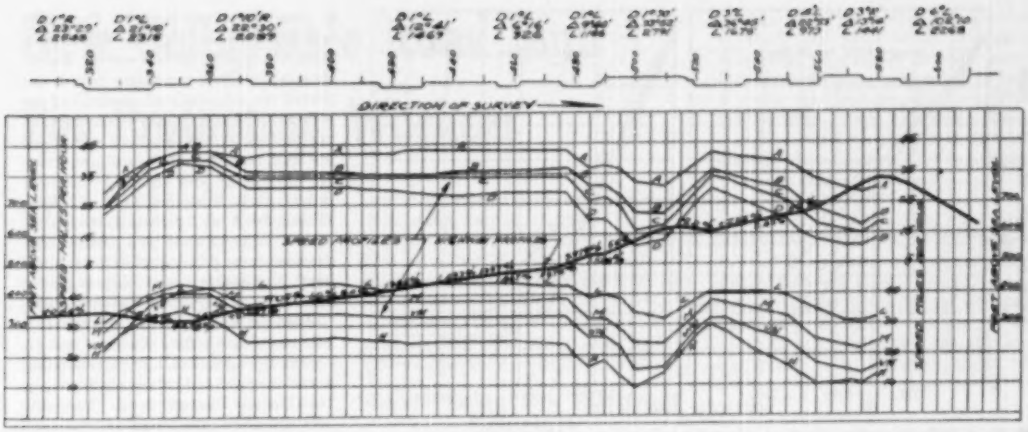
By Gross Vehicle Weight (GVW)	
Light	Up to 15,000 lb.
Medium	15,000 to 30,000 lb.
Heavy	30,000 to 50,000 lb.
Very heavy	50,000 and over lb.

Truck speeds in each group were averaged, then plotted as the lower profile, typically shown in Fig. 1. Because of the inconsistencies noted in the relations between groups, the groupings were then rearranged in the ratio of lbs. of GVW per gross brake horsepower (BHP.) as follows:

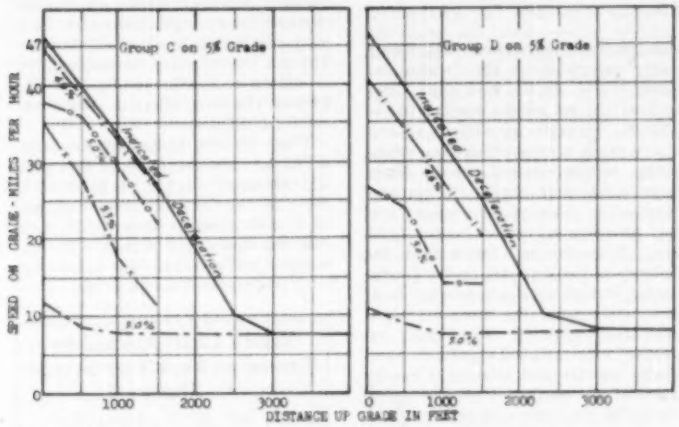
Group A—Up to 199 lb./BHP.
Group B—200 to 299 lb./BHP.
Group C—300 to 399 lb./BHP.
Group D—400 and over lb./BHP.

(The brake horsepower rating was obtained from the manufacturer's rating.)

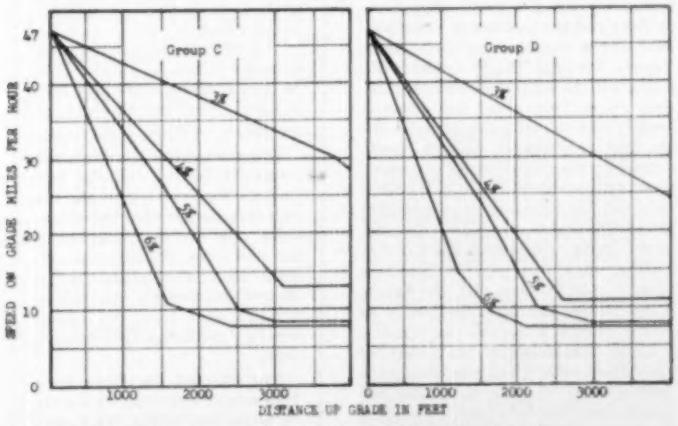
The re-grouped report sheets were



★ Fig. 1. One of ten profile sheets drawn from the survey. Curves A, B, C and D represent vehicles of various bracketed values of "ave. lb./B.P.H." One half the vehicles were in "very heavy" G.V.W. classification. (Taken from Survey Report Fig. 4, U.S. 80 at Telegraph Pass, Ariz.)



★ Fig. 2. Speed profiles taken from appropriate parts of the basic profiles of test sections. Heavily loaded (ratios C and D) trucks on 5% grade—various broken lines indicate actual deceleration observed at selected test stations. Solid lines show probable deceleration assuming 47 mph. (max. "open road" truck speed) instead of observed entry speed into test grade. (Fig. 30 and 31 of test report)



★ Fig. 3. Indicated action on 3%, 4%, 5% and 6% grades of various weight/hp. ratio groups (C and D shown here). (Fig. 38 and 39 of report)

carefully studied individually and as a group. The trucks which showed speed variations of more than about 10 mph., in either direction from the group average, were discarded if the record showed any of the following possible contributory causes:

(1) Extreme (20%) overloading compared to other similar powered trucks.

(2) Trucks reported by the operator to be in poor condition.

(3) All trucks compelled to slow down any time by an uncontrollable cause, such as: a slower vehicle ahead; cattle on the road; parked cars, etc.

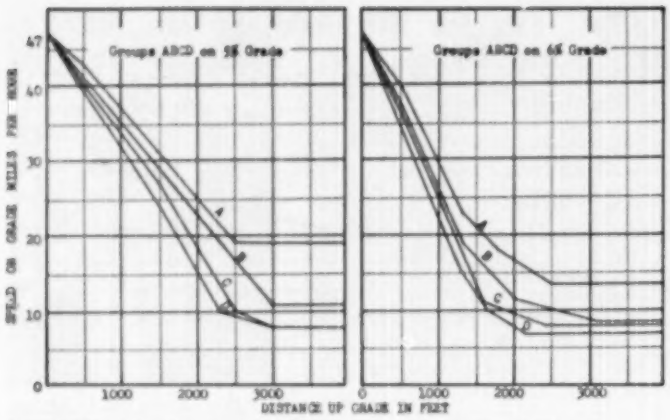
About 9% of the surveyed trucks were thus eliminated.

II—Survey Locations

Nine locations were chosen which included some of Arizona's most famous mountain grades, such as Gonzales Pass on US 60 and 70, some 50 miles east of Phoenix. Some test sections included Radar speed machine checks of traffic in both directions.

III—Field Operations

The Station location possibilities were limited by several factors. Surveys were conducted only at locations where budget funds for other surveys had been allotted. These areas were further limited to the mountainous portions of the State due to the nature of the survey, and finally to routes and sections of routes where the known traffic included rather high percentages of heavy trucking units.



★ Fig. 4. Indicated action of various weight/hp. ratio groups on 5% and 6% grades. (From Fig. 42 and 43 of report)

Within these limits, however, a sufficient amount of 6% grade was available. In no place were the conditions ideal—that is, having more than 2000 ft. of plus grade approached by sufficient level or less than 1% grade to allow the subject vehicle to attain a normal operating speed and then decelerate to the final speed imposed by the grade. Grades of more or less than 6% with favorable approach conditions were not available except in lengths of 1500 ft. or less. While graphs have been prepared showing the observed performance on the other various grades, no precise conclusions were reached as to final sustained speeds on other than 6% grades. On some lesser grades speeds closely approaching sustained speeds were observed, and similar patterns were repeated and identified, at more than one Station. From these, probable sustained speeds were reduced and are believed to be reasonably accurate.

Checked Every 1,000 Ft.

Prior to beginning work in the field, a preliminary survey was conducted at one station. Random vehicles were observed as to the lowest speed reached and the location of places where appreciable speed changes took place. It was decided that observations on speed and time made at 1000-ft. intervals would usually be sufficient. For the purpose of quick identification of these interval points, lath markers were prepared. These were made by tacking a 1¼-in. wide red ribbon around the lath and directly below that, securing a 1¼-in. piece of reflecting "scotch lite" material for night use. These markers were easily recognized in both daylight and darkness, and proved to be satisfactory.

The procedure of establishing a survey station and conducting the survey was generally as follows. The 8-man party assembled at the location at about 3 PM. on the first day. Three or four men set out the markers at the 1000-ft. intervals, as well as at any sharp grade breaks which the preliminary survey showed would likely cause a change in speed. The markers were set by chaining from known survey monuments, culbert center lines, etc. While this was being done, the balance of the crew set up the Loadometer station at a pre-selected location, and placed the necessary signs and traffic controls. The "traffic recorder" man installed a portable automatic counter and selected a nearby location for making a manual count. At 4 PM. the count and survey began, and operated continuously until midnight. The manual count was checked against the machine traffic counts each hour on the hour.

At all except two stations, weighing and interviewing were conducted before the speed survey. One man, in charge of the loadometer crew, was temporarily commissioned as a Motor Vehicle Division Traffic Officer. He conducted the interview, recorded the data on a form sheet and directed traffic when stopping the subject vehicle, then re-entered it into the traffic stream at the conclusion of the interview. Two or three men, as available, weighed and measured the truck in the same manner as a regular Loadometer Survey, recording the data on another form. At most stations, the vehicle operator was told the nature of the survey and asked to drive in as nearly normal a manner as possible.

Upon completion of the interview the subject vehicle was returned to the flow of traffic and the survey car followed, carrying three men. The driver maintained an even interval from the subject truck of approximately 50 ft., and kept as close to the right shoulder as possible. The driver also read the speeds on the survey speedometer and from the safety mirror reported the approach of overtaking vehicles. Another man observed the markers as each was passed and asked for and recorded the speed and time. He also noted and recorded the time any traffic in the same direction either slowed down and remained in line or passed without time loss. Other congestion data, passing violations, accident possibilities, and any observed data deemed pertinent were recorded.

Another man in a car parked at a predetermined point, observed and recorded the speeds of all vehicles, using a radar speed-meter manufactured by the Electric Signal Corp. The subject vehicle's speed was checked and recorded on a chart, giving a continual check on the survey speedometer. This procedure was followed at all stations. The men interchanged the various jobs to relieve monotony and to gain experience in case absence should require substitution.

These surveys were conducted from 4 PM. to midnight, the first day, usually Monday; started again at midnight of the next day continuing until 8 A.M. (Wed.); then 8 AM. to 4 PM. the next day (Thurs.). The automatic traffic counter was left in op-

(*Continued on page 63*)

Truck Lane Added to Tunnel as Result of Grade Study

As one direct result of the study of truck crawl speeds on long mountain grades, described in the accompanying article, the Arizona highway department had no trouble in securing Public Roads OK on addition of a truck lane through a 1200-ft. tunnel planned.

This $700,000 tunnel is on the Superior-Miami leg of U.S. 60-70, and represents the last link in a bold and costly relocation of this steep, twisting line.

The road grade through the tunnel is 6.34%, and the line through the bore represents the only tangent in the immediate area. The original plan called for two lanes, divided by a median curb. The grade studies showed conclusively that heavy trucks will have to crawl through the entire 1200 ft. at 6 mph.

The modified plan includes a 2-lane 24-ft. roadway, with a 12-ft. truck lane on the uphill side, separated by a divider strip.

New Collapsible Road Sign For Protecting Workers

DEVELOPMENT of a new collapsible warning sign for use by highway workmen is announced by S. T. Vosburgh, Director of the bureau of safety, New York state department of public works.

Design for the steel folding standard and sign was originated by the department's staff. Commercial development of the sign is in the hands of the Cataphote Corporation, Toledo, Ohio, the company which originally cooperated in the manufacture of the standards. The sign inserts were made and painted at the D. of P. W. sign shop at Hamburg, N. Y.

The standard is 36 in. long at the base with a slightly shorter inner cross-piece. The framework is 35 in. high surmounted by two 18 and 24 in. red flags set at 60-deg. angles in the handle located in the center of the top of the frame. These flags will be parallel with the sign insert.

One of the legs revolves on a center bolt and is held in either the open or closed position at the proper tension by a coil spring.

One face of the sign, painted yellow, reads "ROAD WORK AHEAD" and is designed to face traffic from the right-hand shoulder from a point 200 to 500 ft. ahead of the point where work actually begins. Reverse side of the sign is white with black lettering saying "WORK ZONE ENDS", to advise travelers leaving the area.

The sign insert is easily removable, to permit a flexible use of the frame for specific warning information such as "TREE WORK," etc. Other advantages are its low center of gravity and its broad base for stability. The yellow face is a signal for caution; the red flags are a warning for approaching danger; and the white face is to notify the driver that he has passed through the work area. The whole assembly is an "Attention Getter" aided by motion when the flags are waving and the sign is swinging in the breeze.

All highway construction crews of the Department have been supplied with signs, two to a crew. "We look forward to the day when the sign will be so widely used as to permit universal recognition by members of the traveling public," said Mr. Vosburgh, remarking on the wide variance in signs used today and the resulting confusion as to their meaning.

Centerlining Job Far from Complete

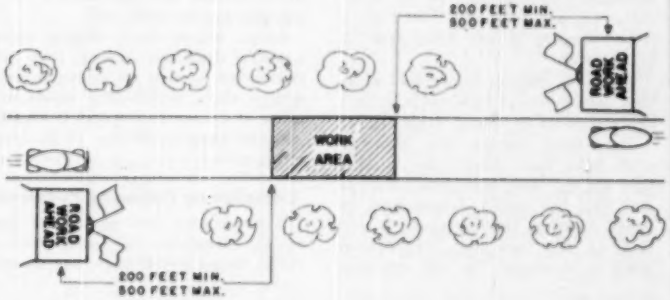
One-third of America's surfaced highways are now center striped, according to PRA figures. Cost of striping and restriping 100,000 miles of highways each year is estimated at $2,800,000, or $28 per mile.

Studies by ARBA based on these estimates show that in spite of all efforts to secure uniformity, center striping is still widely diversified. Some states use solid lines, others broken lines. Widths vary, as do colors, with white and yellow predominating. One state is using a built-in black center line on new concrete pavements. This is done by working in black iron oxide before the pavement sets. A slightly raised separation obtained by concrete slats or bars is being tried out in other states at special points such as curves, intersections where prohibition of passing and left turn is especially important. However, this offers disadvantages in snow removal.

The high cost of painting the center stripe is causing considerable experimentation by state highway departments, the study shows. Several states have developed motor driven striping equipment of special design in an effort to cut costs. Tests are also being made with different types of paints.

●

An example of the safety side of highway improvement is afforded by the Troy-Schenectady Road in upstate New York. A 7½-mile section recently re-aligned, completely rebuilt as a 4-lane divided concrete highway to modern standards, was the scene of 352 reported accidents in the 13 years from 1937 to 1949, inclusive. The old route was tortuous, narrow, hill-and-dale, and hazardous the year around; the new route has easy curves and grades and long sight distance which anticipate reducing the accident rate to a very small percentage of the former rate.



★ Sign is adaptable to many wordings and uses

★ Showing recommended location planned to give ample advance warning for motorists

Rock Drilling Equipment

It's Selection for Road Construction

Prepared by the technical staff of the Le Roi Company, this article is an excellent summary of current practice

HAND-HELD sinkers or jackhammers are generally classified by weight and range from about 20 lb. to 80 lb.

Light 20 and 35-lb. drills are generally used for secondary drilling which involves drilling small holes in boulders and rock not completely broken by previous blasting. This work is confined to light machines because often it is necessary to drill at horizontal or above horizontal angles.

The 45-lb.-class sinker is most generally used for vertical drilling up to a depth of about 10 or 12 ft.

The 55-lb.-class drills have much the same characteristics as the 45-lb. units, but are more often used when it is necessary to drill holes over 10 ft. in depth.

Big 80-lb.-class drills are used when very deep holes are required in terrain not accessible to wagon drills.

Hand-held sinkers for highway work have their advantages in that they are the least expensive machines and can be readily transported in rough country. Drilling speed is limited by the fact that jackhammer work is strenuous for the operator and a new steel must be used at about 2-ft. intervals.

Wagon Drills

Wagon drills are used when the amount of drilling to be done or the increased drilling speed required warrants the use of more expensive equipment. They are essentially the same hand-held machines mounted on an air-feed boom which utilizes air pressure to feed and retract the drill.

A wagon drill with 45 or 50 lb. class, hand-held sinkers will drill about three times as fast as the hand-held machine alone—partly due to the characteristics of the air feed and partly to the fact that longer steel changes may be employed.

Large wagon drills employ more powerful drills and in most rock can drill twice as fast as a wagon drill with a 45-lb. sinker. The added expense of a large wagon drill is usually justified when holes over 10 ft. deep are required.

Compressor Capacity Required

The common 105 cubic feet per minute compressor can operate two or three 20-lb.-class sinkers, one or two 35-lb.-class units, or one 45 or 55-lb.-class drill with ample power available for air to blow chips out of the drill holes.

The 80-lb.-class, shaft-sinking-type drill requires a 160-cfm. compressor.

A large wagon drill with 4-in. bore will require 315 cu. ft. of air although two of certain makes of wagon drills can be operated from a 500 cu. ft. compressor.

Size of Hole Drilled

The commonest size bit used for the bottom of a hole drilled with a hand-held sinker is 1¼ in. The size is usually changed with every 2-ft. steel change so that a hole 6 ft. deep would be drilled with a 1½-in. bit for the first 2 ft., and 1⅝ in. for the second 2 ft., and a 1¼-in. bit from 4 ft. to 6 ft. This sized hole would accommodate the commonly used 1-in. diameter blasting cartridge. The small hand-held sinkers and large wagon drills will use correspondingly smaller and larger bit sizes and powder sizes.

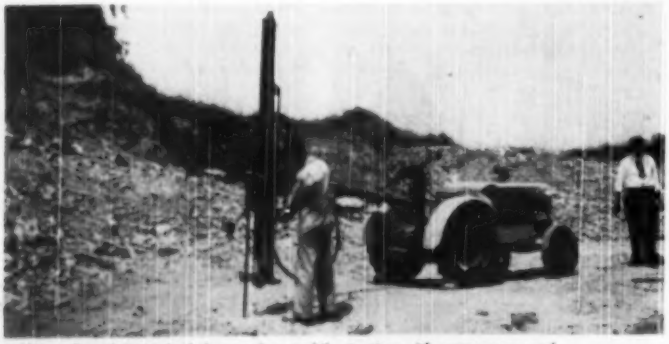
Drilled Hole Pattern

The pattern of holes drilled to accomplish a given blasting job will vary greatly with the type and size of powder used, the hardness of the rock and the structure of the rock. Holes may be spaced as close at 12 in. or as far apart as 6 ft. Other conditions entering into the selection of a pattern are the degree of fragmentation desired, the allowable vibration and the throw of the blasted rock. Average drilling for average rock requires holes spaced about 3 ft. apart in three or more rows that form a triangular pattern.

The rows of holes for a pattern are drilled individually by the hand-held jackhammer operator, in a line with a wagon drill, the operator pushing or towing the unit between holes.

Cost of Rock Drilling

The varying drilling conditions and amount of drilling to be done confound the efforts to set a definite formula for the cost of rock drilling.



★ **New Development:** Labor saving mobile tractor with compressor and swivel boom arm for spotting pattern of holes from one tractor position

Drilling Data—Typical Recent Rock Excavation Jobs

Type of Machine used	Jack-hammers	Jack-hammers	Jack-hammers	Jack-hammers	Heavy wagon drill	Jack-hammers	Jack-hammers	Heavy wagon drill	Jack-hammers	Heavy wagon drill
Kind of Project	Highway Cut	Road Job	Highway Project	Tunnel Approach	Tunnel Approach	Sewer Trench	Sewer Contract	Quarry	Quarry	Quarry
Nature of Rock	Limestone with crevices and seams	Variable shale	Shale-sandstone, granite boulders	Hard and abrasive sandstone	Limestone with mud seams	Hard Limestone	Hard blue limestone	Trap rock	Limestone	Trap rock
Depth of Holes	6' to 13'	14'	6', 4', 13'	8'	11'	5' to 9' Mostly 9'	8' to 10'	20' 6"	12'	22'
Drilling Cost (%)										
Labor	21	27	19	21	28	33	20	30	42	33
Gasoline (or electric power) and oil	32	29	32	33	23	23	24	20	23	17
Repairs	3	5	6	2	3	3	4	5	4	8
Drill Steel Expense	23	25	24	24	30	25	24	26	17	25
Overhead, including interest, depreciation, Taxes, Insurance, Field Office Expense	21	14	19	20	16	16	29	13	14	12
Feet drilled per day by one machine	200'	200'	250'	60'	100'	151'	125'	130'	200'	80'
Lineal feet required to break one cubic yard	1½'	1.66'	1.12'	3'	.75'	7.2'	3'	3'	0.7'	3'
% drilling cost of total drilling and blasting cost	25	25	29	27	98	11	21	25	35	24

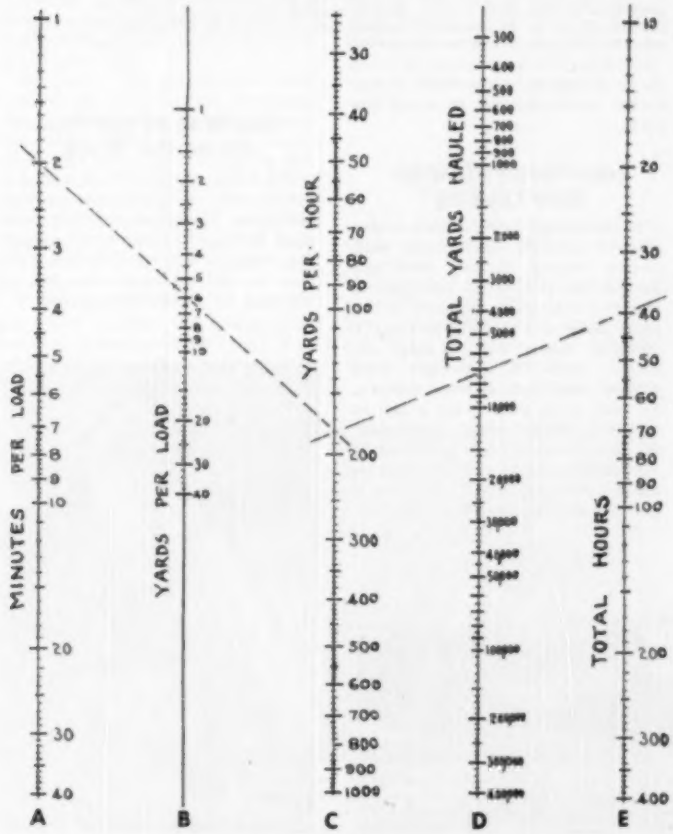
However, a number of different jobs have been tabulated with percentage or breakdown of the drilling cost and relative cost of drilling and blasting.

Drilling units designed for specialized conditions are available to overcome obstacles that make ordinary drilling practices inefficient.

Handy Yardage Chart

This chart gives the cubic yards of earth (or anything) you can move in any number of hours, given rate and size of loads

By W. F. Schaphorst, M. E.



LET us say that you can handle 6 yards of earth every two minutes. How many yards can be hauled in 40 hours?

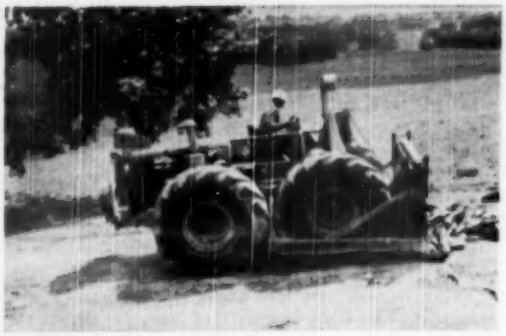
Run a straight line through the 2 in column A and the 6 in column B. The intersection with column C then tells you that you can, at that rate, haul 180 yards per hour. Then run a line through that intersection in column C and the 40 in column E and column D tells you that you can haul 7,200 yards in 40 hours. The dotted lines across the chart tell the story.

The range of the chart has been made great enough to cover most jobs. However, if the hours in column E are insufficient, merely add ciphers. Thus, for example, if the total number of hours is 4,000 instead of 40 hours, the same dotted lines can be used and the answer will be 720,000 cu. yd. You add as many ciphers to the figure in column D as were added in column E.

●

Accurate photo-copies of line drawings to scale are greatly speeded through use of a method suggested by a graphic-arts mechanic at the Norfolk Naval Air Station. Reversing the normal method, the rear of the copy camera is made movable, with the lens fixed. Graduated scales are installed on the bed for use in measuring the size of copy desired, thus making it possible to turn out copies quickly and without unnecessary wastage of film due to guesswork.

JOB and EQUIPMENT IDEAS



Removing Old Black Top Easy with Pneumatic Dozer

Scarifying and blading, aided by a tractor-drawn rooter when necessary, which is the time-honored way of tearing out old bituminous mat, has a rival in the new rubber-tired bulldozer, it seems. A Super C Tournadozer has been employed with good success by a Michigan road contractor to remove old black top materials before repaving.

The photos shown here were taken on a section of U.S. 112 near Somerset, Mich., where the Ann Arbor Construction Co. recently completed a job. A mat 2 to 4 in. thick and 20 ft. wide was removed from about 8300 lin. ft. of roadway. The single machine was able to loosen and remove the material from a maximum of 900 ft. of road per working day, despite constant handicap of heavy traffic. Route 112 is one of the main highways between Detroit and Chicago.

Superintendent Clifford J. Anicka reports unit costs considerably lower than for other methods tried, one of which was the use of a back-hoe with a grader blade attached as a biting edge.

The operator worked the project continuously in one direction. As depicted in the photos, the "method" consisted simply of getting one corner of the dozer blade into the stuff and then pushing. Once the blade got well under the crust it became relatively easy to loosen and displace strips of topping, after which it was shoved to the shoulder to await disposal.

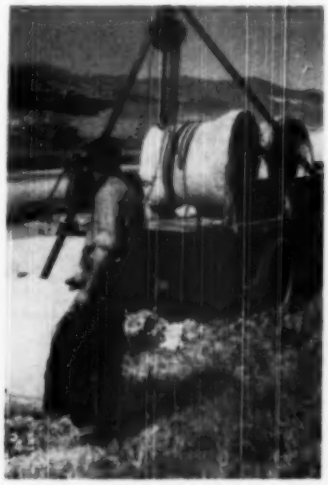
★ Dozer shown making initial ripping or loosening pass along one edge with outer edge of blade tilted down . . . heaping loosened mat on the shoulder . . . (below): piling it on the shoulder for removal. Data courtesy R. G. LeTourneau, Inc., and "Michigan Contractor and Builder"

Road Forms Piled for Easy Loading

In the accompanying scene are neat piles of concrete road forms, each section cleaned in the field and stacked for picking up and moving ahead. Forms were delivered to this point along the job for inspection, cleaning, minor straightening, etc. Twelve forms in each pile were stacked three-high on wood sleepers. No trick at all then to slip a pair of wire rope slings around each stack, for lifting onto a truck or trailer by a truck-mounted crane boom or motor crane. Seen on Guy F. Atkinson & Co. project, Bayshore Freeway, California.

One Way to Get Pipe Up on the Truck

The fellow shown here is one of a 2-man crew of Utah state highway employes. The tripod and chain hoist enabled two men to put heavy pipe on the truck with ease. The pipe, left from a road relocation, was sent to the yard for re-use when needed.



Record-Sized Rotaries Sent to Alaska

TWO of the largest rotary snow plows ever built for truck mounting will be teamed up with two giant V-plows in "Operation Snowball"—an attempt to keep the Richardson Highway in Alaska open from Valdez to Fairbanks this winter.

Principal stumbling block in keeping the highway open is a 19-mile stretch which crosses Thompson pass. The pass rises to 4000 ft. elevation and during mid-winter is normally covered by 30 ft. of wet, heavy snow with temperatures ranging to 30° below zero.

In the past the snow removal problem on the 19-mile section has been too great to be undertaken by the Alaskan Road Commission. This year's attempt is a joint effort by the ARC, Alaska Freight Lines of Fairbanks and the citizens of Valdez. Headed by President Alfred Ghezzi, Jr., the freight company is spending approximately $150,000 for equipment and in operational costs.

Backbone of the freight lines' snow removal fleet will be four Kenworth (Model 888) trucks. Two trucks will carry Bros Model M9 rotary plows. These two units are said to be the largest truck rotaries ever made. Past experience has proved that if this hitherto unconquered section of highway is to be kept open the most powerful, versatile and fastest moving equipment must be used.

The rotary plows are 9 ft. wide and have double "V" moldboards which force feed powerful twin rotors providing straight-line snow movement.

In addition, the plows are equipped with mountain-type casting chutes and slicer bars to cut a clear 9 ft. full-width path and cast the snow as far as 300 ft. into out-of-the-way places. These same rotaries are adaptable to use horsepower from 135 to 400.

From 12 to 15 men will be on the job most of the winter. Ben Stewart, Superintendent of the Valdez division of the ARC, will supervise the commission's end. John Clark of Alaska Freight will be superintendent. The operation chief specified use of extra heavy material to provide as great a margin of safety as possible since the plows will be working miles from repair shops.

If the operation is successful, it will be the first time in the territory's history that motor vehicles have been able to take freight and passengers from Valdez to the interior during the winter months. Valdez, the farthest north year-around port in Alaska, provides the shortest direct route to interior towns and military bases.

Motl Comments on Truck Problem

C. L. Motl, Maintenance Engineer, Minnesota Dept. of Highways, writes the editor:

"I was very much interested in your editorial entitled 'Time for New Action of Heavy Vehicles' in the November issue of ROADS AND STREETS, which I read in its entirety.

"Going on a little farther in this same magazine, I noticed an article 'What Size Tires.' In this article it would be only natural for the truck designer to think of only three vital functions that the tire should perform, all of which relate to the truck.

"Another very important function of tires on trucks which will be more widely recognized in future years, will be that of protecting the highway. It is quite possible that in future years permissible wheel loads, particularly on secondary roads, will be substantially reduced, while at the same time tire sizes will be substantially increased, with corresponding reductions in air pressure. Requirements of this nature would result in a much better distribution of load over the highway surface.

"The present 9,000-lb. wheel loads, with high pressure tires on vehicles traveling at high speeds, are undoubtedly a substantial contributing factor in the destruction of highways, as well as the trucks—as pointed out in the article."

Meetings Ahead

Associated Equipment Distributors: 31st annual meeting, Stevens Hotel, Chicago; January 15-19.

National Sand & Gravel Assn.: 34th annual convention; Stevens Hotel, Chicago; January 22-27.

National Ready Mixed Concrete Assn.: 20th annual convention; Stevens Hotel, Chicago; January 22-27.

National Crushed Stone Assn.: Stevens Hotel, Chicago; January 30-Feb. 4.

Constructors Assn. of Western Pennsylvania: William Penn Hotel, Pittsburgh, Pa.; February 3.

Association of Asphalt Paving Technologists: Hotel Statler, St. Louis, Mo.; February 6-7.

The Moles: Annual award dinner; Waldorf-Astoria Hotel, New York; February 9.

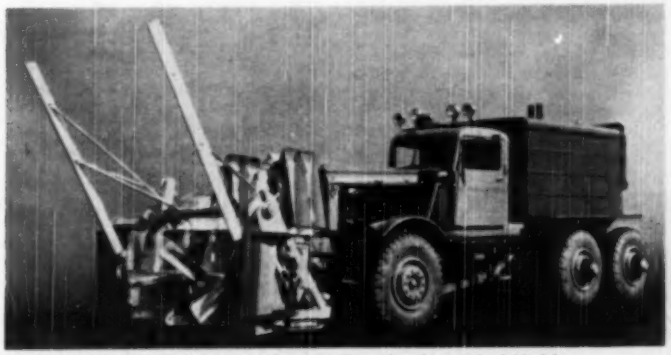
Association of Highway Officials of North Atlantic States: Hotel Statler, New York; February 20-23.

Associated General Contractors of America, Inc.: 31st annual convention; Palace Hotel, San Francisco; February 27-March 2.

American Road Builders' Assn.: 47th annual meeting; Netherland Plaza Hotel, Cincinnati, Ohio; March 6-9.

University of Utah, 11th Annual Highway Conference; Salt Lake City, March 29-31.

Third Highway Transportation Congress, sponsored by National Highway Users Conference, Mayflower Hotel, Washington, D. C., April 26-27.



★ Alaska Richardson Highway snow clearing will employ the standard Model M9 Bros rotary with mountain-type casting chutes and slicer bars. Shown here on a Model 888 Kenworth truck with 400-hp. twin GM diesel rotary power units, ready for Alaskan service

Stockton Test Shows Need for Re-evaluating Existing Runways

Value of deep compaction, and saving effect of new multiple-wheel landing gear, emphasized in conclusions in report of accelerated traffic test, presented to Chief of Engineers

NUMEROUS conclusions of interest to engineers in highway as well as airfield pavement design are contained in a report made recently to the Chief of Engineer, Department of the Army. Entitled "Accelerated Traffic Test at Stockton Airfield (Stockton Test No. 2)," this report summarizes exhaustive studies covering several years, conducted under a research contract by O. J. Porter & Company, consulting engineers. It represents an extension of findings reported in 1942 on Stockton Test No. 1 as well as other accelerated traffic tests performed by the office, Chief of Engineers.

With the report, which is given only limited circulation, are six bulky appendices which contain 372 plates and which analyze data from more than half-million measurements of pressures and deflections transmitted to subgrades. Pressure readings to depths as high as six feet are included, for wheel loads of 35,000, 60,000, 100,000, 150,000 and 200,000 lb., under a wide range of temperature and traffic conditions.

Tests to Failure

The investigation was accomplished by constructing a test runway embodying 25 different pavement designs. Determinations were made of pressure distribution and deflection of pavement, base, subbase, and subgrade for all loads and other variables. The sections finally were tested under traffic of a 200,000-lb. wheel load on an airplane tire until the strength or weakness of the various sections became clearly defined.

Some of the more significant conclusions are as follows:

1. A properly designed asphaltic concrete pavement on an adequate base and subgrade will support loads up to 100 tons per wheel. Pavements of only 3 and 4 in. in thickness performed well when the support was adequate.

2. A clean sand subgrade or subbase makes an excellent foundation and is capable of carrying 100-ton wheel loads when compacted to a high degree and reinforced by 12 to 15 in. total thickness of high-quality rock base and pavement.

3. The base and sandy subgrade materials were compacted by the test traffic to an extremely high density, ranging from 105% to 110% modified AASHO and to depths of as great as 60 in. Even the strongest sections settled two to three inches under traffic, despite the fact that the runway was initially compacted with heavy rollers to much higher density than is usually specified.

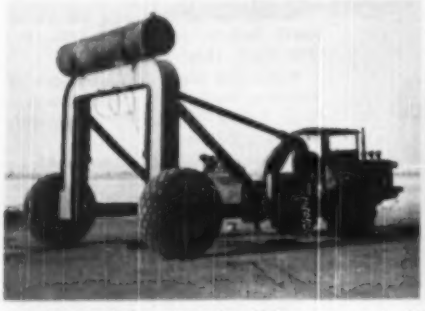
4. The use of widely spaced dual and multiple-wheel assemblies on large aircraft will greatly increase the carrying capacity of many of the existing airports. Depending first on the soil conditions and secondly on the spacing and pressure of the tire, the existing evaluations of airport capacities, which are based on single wheel loads, may be more than doubled in many cases for twin-tandem wheel assemblies such as recommended by the Army Board of Consultants and finally adopted for use on recent models of the B-36 bomber.

Bears on Truck Problem

These findings, particularly 3 and 4, have many important applications to the design of both highways and airports. As an example, the findings remind that the use of multiple axles would greatly reduce the destructive effect of heavy trucks on present roads and permit major economies in the design of new highways.

The study indicates the need for making a re-evaluation of airports for the various dual and multiple wheel assemblies on modern aircraft. A comprehensive study of the subject in cooperation with aircraft designers would undoubtedly produce major improvements in the large airplanes of the future.

This report is one of a series prepared by O. J. Porter and associates on various phases of the design and construction of both asphalt and concrete pavements. Copies of the report are available from O. J. Porter & Company, 516 9th St., Sacramento, Calif., under Chief of Engineers authorization, for $3.00 plus postage.



★ Left: One of the test rigs by which pressures up to 100,000 lb. per wheel were applied to pavement sections. Right: Stone base examination in progress. Extreme density and tightness observed here, such that vigorous action with a pick was necessary to dislodge stone particles

CAA Appoints Macatee to Study Airport Access Roads

Appointment of Walter R. Macatee to represent the CAA in a program of encouraging the development of highways between cities and airports to reduce ground travel time was announced today by D. W. Rentzel, Administrator of Civil Aeronautics.

Mr. Macatee will work with the Bureau of Public Roads, State highway departments and local officials. The Bureau of Public Roads and the CAA will participate in a joint study of speeding highway transportation to and from airports.

In making the announcement, the Administrator stressed that CAA's participation in the highway program will be to encourage the sound and economical use of city-to-airport highways to increase their traffic capacities. Federal Airport Funds will not be used for these purposes.

Recent studies have indicated that average savings of travel-time between a number of cities and their airports could be reduced by approximately one-third by the installation of modern highways.

Research Pays Dividends

(*Continued from page 46*)

Corresponding figures were 6.2 and 8.0 for county, township and other local roads only.

6. Continued high, and sometimes greatly variable, local road maintenance costs prompted some analysis. For example, it was found that blading operations ranged from 4 to as many as 160 trips per mile on individual road sections checked. Cost per blading ranged from $1.67 to $7.25 per mile. Total maintenance cost per mile per year varied from $18.50 upward, averaging $93.93. Admitting the great variation in road conditions, type, traffic, etc., it is seen from such data that motor grader work, presently a principal effort on hundreds of thousands of miles of local roads, is a critical factor in highway cost and worthy of systematic study with new economies in mind.

7. Ditch cleaning figures also showed great variation. One to 3 cleanings annually are common practice, and costs per cleaning vary from $7.60 to $45.00 per mile, depending on job to be done and degree of mechanization.

8. Roadside mowing—costs analyzed vary from $1.60 to $49.26 per mile, for mowings, one to 4 per year.

9. Snow removal costs on different roads in the same locality vary in the extreme, depending much on whether the grade line is raised. One example cited shows road A cost seven times as much as road B to clear, due to drifts, the relative saving for B representing more than the grading cost over a 20-year period.

Rapid Stability Test

New Stability Test. A new test for determining stability of hot-mix at the plant, notable for its speed (10 minutes), was presented by Ting Ye Chu and M. G. Spangler, Iowa Engineering Experiment Station. It involves use of a single mold for both molding and testing, which eliminates need for extruding the specimen. Also involved is an armored thermometer which measures the specimen before testing, eliminating the hot-water bath for the specimen.

Concrete Joint Sealing. Construction practice (new projects) was questionnaired by committee D-3, Wm. Van Breeman, chairman. Of 39 states replying, 37 do concrete construction. Of these, 15 report use of no expansion joints except at bridges, end of run, etc. Nine states space expansion joints 300 to 600 ft.; six states, 100-200 ft.; seven states, less than 100 ft. Trend continues to be toward fewer joints. The preference is decidedly toward non-extruding types of premolded filler, and engineers are still seeking the perfect filler.

Contraction joints: 33 of 37 reporting states install them, 22 employing the dummy groove. Eight states use thin paper strips; two, full-depth plates.

Subsealing: 15 states use rubber-asphalt (thermoplastic) compounds exclusively and all users are enthusiastic. Eight states use this type as alternate; 23 employ ordinary asphalt sealers, 14 exclusively. Mixed reports were given on satisfactory results of the asphalt type sealers. Chief complaints against thermoplastic types: difficulty to heat without burning, and other troubles in application. Cleaning of old joint before sealing is prevailing practice. Joint sealing problems are far from solved. The report is being given study before formal issuance.

A subcommittee report on joint materials in concrete pavements, covering maintenance as well as new construction, was presented by A. A. Anderson, Portland Cement Association, chairman. Data from this report will be presented in a later issue of ROADS AND STREETS.

Soils vs. Spring Thaw

Several papers were given correlating soil conditions with pavement service conditions. One by the committee on frost effect on load carrying capacity, headed by C. L. Motl, continued with data on Minnesota and other studies emphasizing the seriousness of the load problem during spring thaws.

A paper, "Pavement Performance Correlated with Soils," by J. C. Stevens, A. W. Maner and T. E. Shelburne, covers 18,000 miles of Virginia road. Primarily a study of spring break-up conditions, this elaborate report gives numerous conclusions. A few: Certain Virginia soils types are consistently good, others poor performers during thawing. The study demonstrates the value of studying soils on an area basis, and of further investigations of this type. Air photos constitute one of the most promising aids.

Soil Bearing Capacity

Primary roads survived thaw better than secondaries, despite heavier traffic. Low-type bases of so-called stabilized material were adequate only in areas of soils having good supporting characteristics. Surfaces included in the survey were primarily bituminous; high types stood up best.

A thought provoking paper was given under title, "Some Laboratory Studies of Factors Pertaining to the Bearing Capacity of Soils," by Harmer E. Davis and Richard J. Woodward, University of California. The purpose was to stimulate renewed thinking on the problem of the supporting capacity of soil masses under surface loads. The data given are primarily qualitative, intending to highlight some observations on soil behavior and perhaps lead to other research. The paper briefly describes findings from small-scale bearing capacity studies.

Professor Moyer New HRB Chairman

During the annual meeting the following changes in officers and members of the executive committee were made:

Professor R. A. Moyer, former vice chairman, becomes chairman of the executive committee for the coming year. Professor Moyer is research engineer at the Institute of Transportation and Traffic Engineering, University of California.

R. H. Baldock, state highway engineer of Oregon; elected for a second 3-year term on the executive committee, and vice chairman of the executive committee for 1950.

W. H. Root, engineer of maintenance, Iowa state highway commission; to the executive committee for a 3-year term. Mr. Root was the first chairman of the Board's maintenance committee which later became the department of maintenance, serving from 1922 to 1927; chairman of the maintenance department since 1938.

H. P. Bigler, executive vice-president of the Connors Steel Company, Birmingham, Alabama, to executive committee for 3 years.

Retiring executive committee members are Professor R. L. Morrison, U. of Michigan; and Stanton Walter, National Sand and Gravel and Ready-Mix Concrete Associations.

N. Y. Personnel Training

Plans for the development of intensive and practical training programs for the personnel engaged in varied activities of the New York State Department of Public Works are being formulated, according to superintendent of public works B. D. Tallamy.

Valuable material for the development of operational methods and details for this unique plan was secured from a two-day conference, at which top level engineers from all the ten district offices of the Department met with central office officials to discuss guiding policies.

Rapid expansion of the personnel of the Department during the past several years, has been necessitated by enlarged programs in construction of highways and other public works.

Rotaries and Front-End Loaders

Do This City's Autumn Street Clean-up Job

By F. M. Galloway
Town Engineer, Montclair, New Jersey

WE started using a Sno-Go for picking up leaves in 1940 and have found the operation very satisfactory. Prior to mechanization of the operation, when labor was only fifty cents an hour, our costs were as much as $10,000 a season.

Regular street sweeping is kept going until the volume of leaves on the streets makes it uneconomical to clean by this method. Street sweeping, except in the business districts, is then discontinued for about one week, or until the volume of leaves is sufficient to push up with a push-broom mounted in front of a truck. Leaves from low spots are picked up first, where they are apt to clog catch basins and cause flooding, and from a few areas where an early fall of leaves increases the volume on the streets.

The rotary will handle dry or damp leaves without any difficulty. However, if leaves become completely saturated from continuous rain, we load with front-end loaders instead of attempting to use the rotary unit. We have two Sno-Gos and one extra complete front-end assembly. The old front-end assembly, which has been used for leaf removal work for the past eight years, is kept for that work. All streets are machine-swept after leaf removal operations have been completed.

The increase in volume in 1947 and 1948 (see table) is due to not enforcing the regulation which prohibits property owners from raking leaves from private property into the street. By eliminating earth shoulders where property owners were formerly permitted to burn leaves, we have greatly increased their disposal problem, and, therefore, feel that we must help them.

Year	C.Y. Removed	Cost per C.Y.	Total Cost	Labor Rate
1943	3,196	$0.596	$1,903	$0.75
1944	3,203	0.788	2,849	0.75
1945	3,518	0.56	1,966	0.80
*1946	3,187	0.93	2,949	0.87
1947	4,853	0.69	3,009	0.87
1948	6,382	0.53	3,387	1.05

*A past infection of Norway maples caused leaves to start dropping very early, making it necessary to go over streets more times than usual.

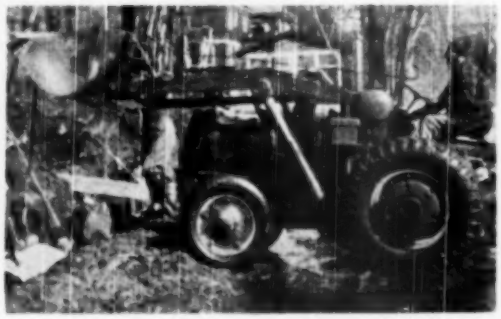
★ Rotary snow plow at Montclair, New Jersey, getting its Autumn warm-up on leaves and debris, in anticipation of a busy winter

New Southeastern Joint Committee Formed

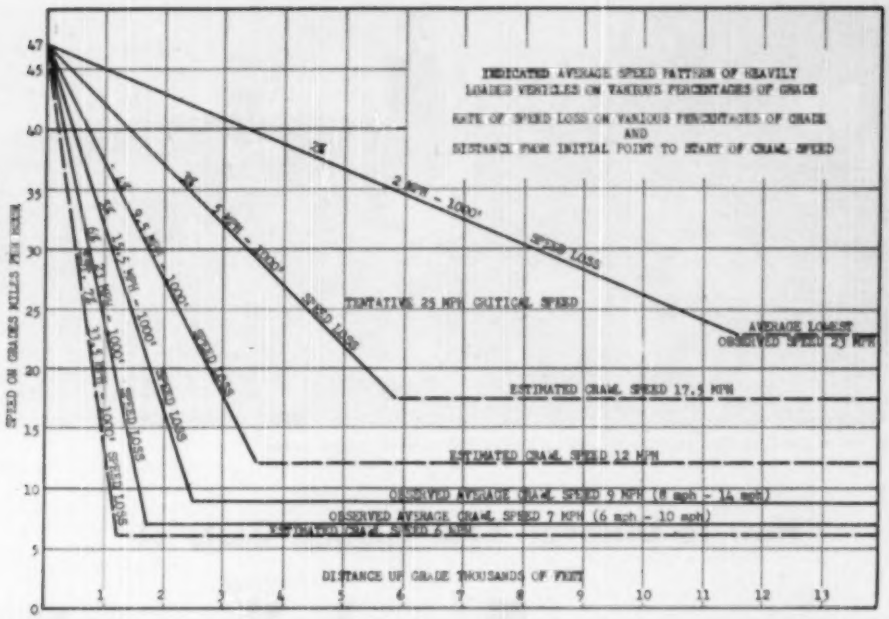
Closer cooperation between highway officials and contractors in the twelve Southeastern states has been assured by the establishment of a joint cooperative committee between the Southeastern Association of State Highway Officials and the Southeastern Division of the American Road Builders' Association. Formal action setting up the cooperative committee was taken at the recent meeting of SASHO in Little Rock, Arkansas.

The group will be formally known as the "Joint Cooperative Committee SASHO-SDARBA."

★ Front-end loaders, of which the City has several, find year-around work. Autumn street clearing and general trash removal is one of their most important duties



★ A city-owned Hough loader helping to backfill trench for sewer repairs at Montclair


INDICATED AVERAGE SPEED PATTERN OF HEAVILY LOADED VEHICLES ON VARIOUS PERCENTAGES OF GRADE
RATE OF SPEED LOSS ON VARIOUS PERCENTAGES OF GRADE AND DISTANCE FROM INITIAL POINT TO START OF CRAWL SPEED
SPEED IN MILES PER HOUR
DISTANCE UP GRADE THOUSANDS OF FEET
TENTATIVE 25 MPH CRITICAL SPEED
ESTIMATED CRAWL SPEED 17.5 MPH
ESTIMATED CRAWL SPEED 12 MPH
OBSERVED AVERAGE CRAWL SPEED 9 MPH (8 mph - 14 mph)
OBSERVED AVERAGE CRAWL SPEED 7 MPH (6 mph - 10 mph)
ESTIMATED CRAWL SPEED 6 MPH
SPEED LOSS

★ Fig. 5. How heavily loaded trucks are slowed down — chart based on Arizona survey. (Fig. 44 from report)

Uphill Truck Speeds

(*Continued from page 54*)

eration during the entire period of 72 hours at each station.

One week was spent at each of the nine stations. This allowed time each week end for lubrication and repairs to the survey vehicles and checking the other equipment.

IV—Discussion

The profile (such as Fig. 1) sheets were plotted to show speed profiles of vehicles in two groupings:

1. Lb. Gross Vehicle Weight (by loadometer) / Maximum Rated Brake Horse Power = lb./HP.
2. Lb. Gross Vehicle Weight (by loadometer)

In analyzing and presenting the observed data, the grouping by lb./manufacturers' rated BHP. has been used exclusively. A more desirable basis might have been net BHP., which takes into account friction loss in the driving gears, road resistance, etc. However, sufficient data were not available to permit reduction of the gross BHP. values to net figures.

As part of the interview, each driver was asked the operating RPM. of the motor used on the grade encountered. On tachometer equipped vehicles the operator could give an accurate report. Other operators had to estimate.

The results showed that operators of similar vehicles drove at various operating RPM., but remained within the economical operating range. The characteristics of internal combustion engine performance curves being as they are, this RPM. range gives a differential of 25% to 35% of developed gross horsepower. Gross vehicle weights were found to vary through an extremely wide range of similar powered vehicles. (In one case a new Ford F.-8, rated as a 3-ton truck, was found hauling 43,200 lb. GVW. of steel balls for a mine ball mill.)

V—Speed Profiles

Speed graphs were plotted from speed profiles of various sections of 3, 4, 5, and 6% grades for the four weight/HP. ratio groups.

Fig. 5 is a composite of the heavier groups plotted for eight sections. These curves show the probable average behavior to be expected from vehicles loaded to capacity, or nearly so, on the various grades. The speed loss rates (deceleration) per 1000 ft., are believed to be reasonably accurate from the numerous observations of this survey. Crawl speeds on 5% and 6% grades were observed within the range shown in parenthesis. The crawl speeds for the other grade percentages are estimates based on the lowest observed speeds during the survey.

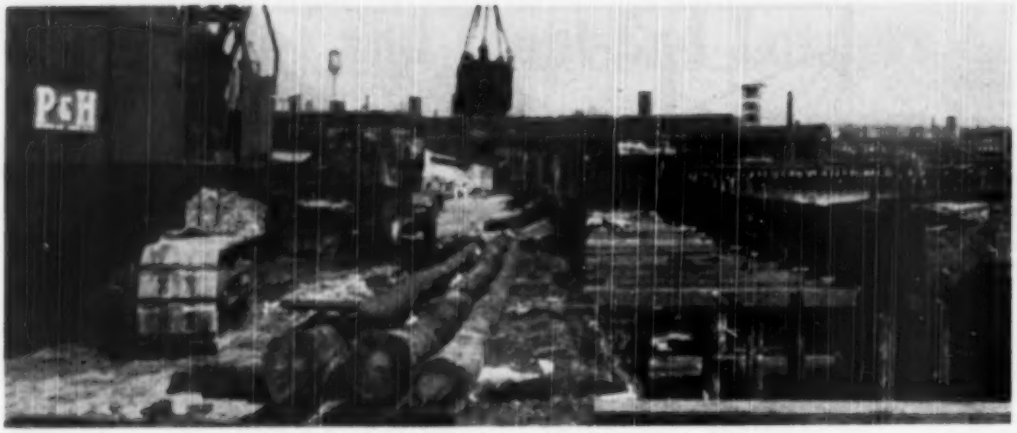
Fig. 6 indicates the deceleration pattern on a 6% grade approached at an average speed of 47 mph. under favorable conditions. In this graph, taken from one of the stations, nearly ideal conditions for the study were found. A 6% grade was approached by 2 miles of level grade. Access was limited to one low-volume road at the foot of the grade entering on the surveyed lane side, and a service station and camp one mile from the foot of the grade on the westbound lane side. Traffic traveled this approach at rather high speeds, with observed speeds of 60-65 mph. for many trucks. These plotted curves represent the total of observed vehicles, as well as portions of that total, averaged for various entrance speeds and weight power ratios. The various patterns show only slight variations throughout the 1500 ft. of the grade, and only a small variation after entering a 1200 ft. vertical curve to a minus grade at the summit.

Average annual daily traffic on the test sections ranged from 1346 to 2342 vehicles per day.

In developing the speed data, it was noted that with equal gross weights, trucks powered with butane or diesel traveled at speeds of 2 mph. to 10 mph. faster than gasoline-powered trucks.

It requires only a glance at the composite chart to see that slow moving vehicles present a real hazard to our highway safety as well as a menace to the ever increasing highway congestion. The Arizona Highway Department has adopted the design policy that no vehicle should travel slower than 25 mph. under any condition. With this in mind a tentative 25 mph. speed line was added to the chart. To use the chart in Arizona it is only necessary to study the highway location plans and proposed profile in connec-

(*Continued on page 68*)



★ Trench employing tight steel sheeting timber bracing and stand-by gasoline pumps

How to Uncover Your Hidden Costs of

Trench Excavation

Whether trench excavation is a major or minor item, the estimation of the cost of doing this work should not be regarded lightly by the contractor

By E. T. Nettleton

Associate Highway Engineer
State Highway Department of Connecticut

PROBABLY no other item common to heavy construction varies in cost to such a wide degree as trenching. Prices may vary from 30¢ to $15 per cu. yd. of excavation. Contractors, all too often, overlook this variation. Often they bid this item on the basis of average bids recently tendered in their locality upon other work.

What makes the actual unit cost for this item vary so much between different projects? In the first place, practically every engineer writes a different specification, describing what the item includes and how the work will be paid for.

They Don't Read Specs

Unfortunately, many contractors pay just about as much attention to specifications before bidding as school boys pay attention to Latin verbs on the opening day of the baseball season. In the second place, this item by its very nature carries many unforeseen problems. Even though many of these conditions are not at first apparent, it is economically and physically possible to detect with a fair degree of accuracy most of these hidden factors. This information could be obtained by the engineer and could be given to all contractors previous to the receipt of bids. Unfortunately, underground information, even when obtained with care, is not always 100% accurate. Engineers realize the possibility of inaccuracies in their finding. Most engineers, fearing that some contractor might later claim that he had been misled, refuse to give any information regarding underground conditions. Whether it is fair to place the entire gamble in the hands of the contractor is another question. The fact is that the contractor, generally speaking, has to accept this risk if he wishes to bid.

Recent studies pertaining to failures incurred in sewer construction and pipe installation revealed the fact that failures are generally incurred by trench excavation rather than by the laying of the pipe itself.

Pays to Investigate

Intelligent investigation will remove many of the unknown risks. This investigation may consist of soundings, conversation with local inhabitants, investigation of neighboring cuts, and examination of public utility blue prints. Thorough estimation of the anticipated costs will remove much speculation. Significant questions are attached to this article to aid the contractor in a thorough investigation of the site and a careful study of the plans and specifications. Forms are also listed to help the estimator in making an orderly listing of the anticipated costs. A general summary tabulation is followed by tabulations giving the individual break-down of the main items listed in the summary. Unless the contractor uncovers his real trench excavation costs, he may become buried in his own expenditures.

Summary of Trench Excavation Costs

(a) General, Job Overhead, Traffic Control _____
(b) Pavement Removal _____
(c) Common Excavation _____
(d) Rock Excavation (excl. of drilling and blasting) _____
(e) Rock Drilling and Blasting _____
(f) Dewatering _____
(g) Bracing, Shoring and Sheeting _____
(h) Mats and Cradles _____
(i) Backfilling _____
(j) Replacement of Unsuitable Backfill _____
(k) Temporary Pavement _____
(l) Permanent Pavement _____
(m) Unusual Circumstances _____
Total lump sum $_____

Total lump sum $

_____c.y. measured for payment

= $_____ Cost per c.y. of excavation

Total lump sum $

_____l.f. allowed for payment

= $_____ Cost per l.f. of trench

General, Job Overhead, Traffic Control (a)

How is trench excavation defined?

How many of the following operations are included?

traffic control—permanent pavement—

pavement removal—bracing—

common excavation—backfilling—

rock excavation—replacement unsuitable backfill—

dewatering—mats or cradles—

sheeting—temporary pavement—

How are the above items paid for?

How is measurement for payment made?

What are the limitations on payment lines?

Does the specifications or handling of traffic limit the length of open trench at any given time?

What will be the method of handling traffic?

Where are underground public utility lines located?

mains .....

laterals .....

Cost Estimate for General Overhead, Traffic Control

Equipment

Trailer moving backhoe or crane to and from job	lump sum	=	———
Daily trucking labor to and from job	hrs @	=	———
Pontoons for unstable ground	lump sum	=	———
Pickup truck	hrs @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total equipment		$	———

Materials and Supplies

Lanterns	each @	=	———
Barricades	lump sum	=	———
Oil for lanterns	gals @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total materials		$	———

Labor

Equipment operator	hrs @	=	———
Common labor	hrs @	=	———
Watchman	nights @	=	———
Flagman	hrs @	=	———
Superintendent	weeks @	=	———
Timekeeper	weeks @	=	———
Carry forward		$	
___% Insurance, social security and taxes			———
___% Profit and overhead			———
Sub-total labor		$	———

Miscellaneous

Cost of permit for service cuts	each @	=	———
Measures to protect other utilities	lump sum	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total miscellaneous		$	———
Total—General cost, job overhead, traffic control		$	———

Pavement Removal (b)

Does old pavement have to be drilled, cut, broken by dropping a heavy weight, removed by rooter, hand or other method?

Cost Estimate for Pavement Removal

Equipment

Compressor incl. hose	days @	=	———
Backhoe	days @	=	———
Jackhammers	days @	=	———
Pavement breakers	days @	=	———
Ball and chain	days @	=	———
Trucks	hrs @	=	———
Shovel	days @	=	———
Carry forward		$	
___% Profit and overhead on equipment			———
Sub-total equipment		$	———

Materials

Gasoline	gals @	=	———
Diesel oil	gals @	=	———
Grease	lbs. @	=	———
Carry forward		$	
___% Profit and overhead on materials			———
Sub-total materials		$	———

Labor

Foreman	days @	=	———
Compressor operator	hrs @	=	———
Jackhammer and breaker operator	hrs @	=	———
Common labor	hrs @	=	———
Truck drivers	hrs @	=	———
Carry forward		$	
___% Insurance, social security, taxes, etc.			———
___% Profit and overhead on labor			———
Sub-total labor		$	———
Total pavement removal		$	———

Estimate, Common Excavation Estimate

Equipment

Backhoe	days @	=	———
Crane	days @	=	———
Trucks	days @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total equipment		$	———

Materials and Supplies

Gasoline	gals @	=	———
Diesel oil	gals @	=	———
Oil	gals @	=	———
Grease	lbs @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total materials and supplies		$	———

Labor

Backhoe operator	hrs @	=	———
Crane operator	hrs @	=	———
Truck drivers	hrs @	=	———
Common (Trimming)	hrs @	=	———
Carry forward		$	
___% Insurance, social security, taxes, etc.			———
Sub-total labor		$	———
Total common excavation		$	———

Common Excavation (c)

What is the type of material to be encountered?

What is the maximum depth of trench?—Width?

Is excavation for structures such as hand walls, catch basins or manholes paid for as trench excavation?

Is the bottom of the trench so unstable that extra excavation will be required?—Who pays for this?

Do the specifications require the last six inches of trench to be excavated by hand?

Do the specifications prohibit overcutting of the depth?

Does excavation for bells on pipe have to be done by hand?

How much hand tunneling has to be done under other pipes or structures?

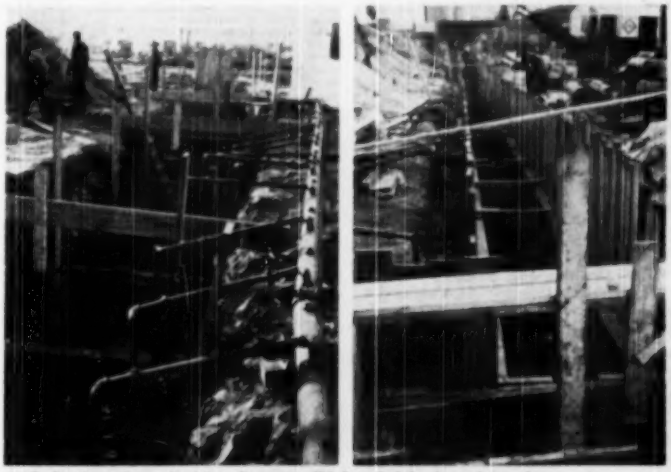
Selection of excavating equipment will depend upon the width of trench, depth of trench, stability of ground surface, amount of material to be excavated per day, all around usefulness

Rock Excavation excl. drilling and blasting

	days @	=	———
	days @	=	———
	days @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total equipment		$	———

	gals @	=	———
	gals @	=	———
	gals @	=	———
	lbs @	=	———
Carry forward		$	
___% Profit and overhead			———
Sub-total materials and supplies		$	———

	hrs @	=	———
	hrs @	=	———
	hrs @	=	———
	hrs @	=	———
Carry forward		$	
___% Insurance, social security, taxes, etc.			———
Sub-total labor		$	———
Total rock excavation excl. drilling and blasting			———



★ *Left:* Braced trench with well points. *Right:* Tightly sheeted trench with well points located outside

★ Trench employing sloping sides, sand bags and stand-by gasoline pumps

of machine and speed at which pipe laying may progress.

Rock Excavation (d)

How is rock defined?

Is shale or hard pan considered to be rock?

Are boulders considered to be rock? —If so what size?

Is back break allowed for payment in rock?

In ledge will rock have to be excavated to a greater depth?

Rock Drilling and Blasting (e)

How close to rock excavation are buildings, bridges, miscellaneous structures, pipe lines, conduits, or pole lines?

What limitations are there in blasting?

Where will storage be located for dynamite?—for caps?

How will explosives be transported?

What classification of rock is involved?

Is the rock solid, full of seams or in layers?

Cost Estimate, Rock Drilling and Blasting

Equipment

Compressor incl. hose, valve, etc.	days	@	=
Wagon drills	days	@	=
Jackhammers	days	@	=
Pavement breaker	days	@	=
Blasting machine	days	@	=
Blasting mats	days	@	=
Carry forward			$
___% Profit and overhead on equipment			
Sub-total equipment			$

Materials

Gasoline	gals	@	=
Oil	gals	@	=
Drill steel	l.f.	@	=
Purchase of bits	each	@	=
Sharpening of bits	each	@	=
Straightening of drill steel	lump sum		=
Dynamite	lbs	@	=
Caps	each	@	=
Lead wires	l.f.	@	=
Carry forward			$
___% Profit and overhead on materials			
Sub-total materials			$

Labor

Foreman	days	@	=
Compressor operator	hrs	@	=
Wagon drill operators	hrs	@	=
Jackhammer operators	hrs	@	=
Licensed blaster	hrs	@	=
Common laborers	hrs	@	=
Carry forward			$
___% Insurance, social security, taxes, etc.			
___% Profit and overhead on labor			
Sub-total labor			$
Total rock drilling and blasting			$

Dewatering (f)

What is the ground level of water? —maximum tide level?

What method or methods of dewatering will be required, hand pumps, machine pumps, well point system or use of cofferdams?

What is the maximum gallons of water per minute to be handled?

Will dewatering be carried on during working hours or twenty-four hours of the day?

Cost Estimate for Dewatering

Equipment

Hand pumps	days	@	=
Machine pumps	days	@	=
Well point system complete	days	@	=
Carry forward			$
___% Profit and overhead			
Sub-total equipment			$

Materials and Supplies

Gasoline	gals	@	=
Electricity	k.w.h.	@	=
Carry forward			$
___% Profit and overhead			
Sub-total materials			$

Labor

Foreman	days	@	=
Pump operators	hrs	@	=
Plumbers (installing points and making connections)	hrs	@	=
Laborers (handing pipe)	hrs	@	=
Carry forward			$
___% Insurance, social security, taxes, etc.			
___% Profit and overhead			
Sub-total labor			$
Total dewatering			$

Bracing, Shoring and Sheeting (g)

What is maximum depth of trench?

What is maximum width of trench?

Is the excavated material of a plastic or unstable nature?

Are the sides of the trench subjected to vibration of traffic?

Are the sides or bottom of trench subjected to ground water?

Which of the two will be required, shoring and bracing or tight sheeting?

What material will be used, wood or steel?

What length of sheeting will be required?

Will the bracing and sheeting be paid for?

Will the bracing and sheeting be left in place?

How will the sheeting be driven?

Estimate for Bracing, Shoring and Sheeting (includes removing if not left in place)

Equipment

Trucks	hrs	@	=
Hammer	days	@	=
Compressor	days	@	=
Pile Driver	days	@	=
Boiler	days	@	=
Carry forward			$
___% Profit and overhead			
Sub-total equipment			$

Materials

Plank sheeting	mbf	@	=
Steel sheeting	tons	@	=
Nails and spikes	lbs.	@	=
Supporting timbers (stringers)	mbf	@	=
Supporting timbers (x bracing)	mbf	@	=
Less salvage value if not left in place			
___% Profit and overhead			
Sub-total materials			$

Labor

Foreman	days	@	=
Common labor	hrs	@	=
Truck drivers	hrs	@	=
Compressor operator	hrs	@	=
Pile driver operator	hrs	@	=
Fireman	hrs	@	=
___% Insurance, social security, taxes, etc.			
___% Profit and overhead			
Sub-total labor			$
Total bracing, shoring, sheeting			$

Mats and Cradles (h)

Is the base of the trench so unstable that mats or cradles will have to be constructed?

Who pays for this construction?

Estimate for Mats and Cradles

Equipment

Trucks	hrs	@	=
Hammer	days	@	=
Pile driver	days	@	=
Boiler	days	@	=
Carry forward			$
___% Profit and overhead			
Sub-total equipment			$

Materials

Wood posts	mbf	@	=
Wood stringers	mbf	@	=

Wood x-bracing	mbf	@	=	———
Wood planking	mbf	@	=	———
Nails and spikes	lbs.	@	=	———
Creosote oil	gals	@	=	———
Gasoline	gals	@	=	———
Oil	gals	@	=	———
Coal	tons	@	=	———
Grease	lbs.	@	=	———
Carry forward				$
___% Profit and overhead				———
Sub-total materials				$———

Labor

Foreman	days	@	=	———
Painters	hrs.	@	=	———
Carpenters	hrs.	@	=	———
Truck drivers	hrs	@	=	———
Pile driver operator	hrs	@	=	———
Fireman	hrs	@	=	———
Common labor	hrs	@	=	———
Carry forward				$
___% Insurance, social security, taxes, etc.				———
___% Profit and overhead				———
Sub-total labor				$———
Total mats and cradles				$———

Backfilling (i)

Can common excavation for trench be used for backfill?

Can pavement excavation for trench be used for backfill?

Can rock excavation for trench be used for backfill?

Where can surplus trench excavation or excavated material which is unsuitable for backfill be deposited?

Can excavated material be piled temporarily alongside trench until used for backfill?

Can excavated material be loaded in trucks and immediately used to backfill nearby trench?

Does backfill have to be placed in layers? What depth?

What type of tamping is required, water, machine, hand?

Will backfill be placed by crane bucket, bulldozer, grader, or other machine?

How much backfilling must be done by hand?

Estimate of Backfilling

Equipment

Trucks	hrs	@	=	———
Backhoe	days	@	=	———
Crane	days	@	=	———
Bulldozer	days	@	=	———
Compressor incl. hose	days	@	=	———
Automatic tampers	days	@	=	———
Carry forward				$
___% Profit and overhead				———
Total equipment				$———

Materials

Water	gals	@	=	———
Gasoline	gals	@	=	———
Diesel Oil	gals	@	=	———
Grease	lbs	@	=	———
Carry forward				$
___% Profit and overhead				———
Total materials				$———

Labor

Foreman	days	@	=	———
Truck drivers	hrs	@	=	———
Backhoe operator	hrs	@	=	———
Crane operator	hrs	@	=	———
Bulldozer operator	hrs	@	=	———
Common labor	hrs	@	=	———
Tamper operators	hrs	@	=	———
Carry forward				$
___% Insurance, social security, taxes, etc.				———
___% Profit and overhead				———
Sub-total labor				$———
Total backfilling				$———

Replacement of Unsuitable Backfill Costs (j)

When material is unsuitable for backfill where can suitable backfill be obtained?

What kind of material must this be?

Cost Estimate for Temporary Pavement

Equipment

Trucks	hrs	@	=	———
Power Roller	days	@	=	———
Ready Mix Trucks	hrs	@	=	———
Oiler	hrs	@	=	———
Spreader or sanding machine	days	@	=	———
Grader	days	@	=	———
Carry forward				$
___% Profit and overhead				———
Sub-total equipment				$———

Materials

Crushed stone, gravel	c.y.	@	=	———
Penetrating oil	gals	@	=	———
Bituminous concrete	tons	@	=	———
Ready mix concrete	c.y.	@	=	———
Carry forward				$
___% Profit and overhead				———
Sub-total materials				$———

Labor

Truck drivers	hrs	@	=	———
Roller operator	hrs	@	=	———
Grader operator	hrs	@	=	———
Foreman	days	@	=	———
Finishers	hrs	@	=	———
Spreaders	hrs	@	=	———
Common labor	hrs	@	=	———
Carry forward				$
___% Insurance, social security, taxes, etc.				———
___% Profit and overhead				———
Sub-total labor				$———
Total temporary pavement				$———

—What does this cost?

If the bottom of the trench is so unstable that it has to be excavated to extra depth and backfilled with gravel or stone who pays for the special backfill?

Cost Estimate for Replacement of Unsuitable Backfill

Equipment

Shovel	days	@	=	———
Trucks	hrs	@	=	———
Bulldozer	days	@	=	———
Compressor (incl. hose)	days	@	=	———
Automatic tampers	days	@	=	———
Carry forward				$
___% Profit and overhead				———
Total equipment				$———

Materials

Purchase of gravel, crushed stone or fill	c.y.	@	=	———
Gasoline	gals	@	=	———
Diesel oils	gals	@	=	———
Oil	gals	@	=	———
Grease	lbs	@	=	———
Water	gals	@	=	———
Carry forward				$
___% Profit and overhead				———
Total materials				$———

Labor

Foreman	days	@	=	———
Truck drivers	hrs	@	=	———
Bull loser operator	hrs	@	=	———
Common labor	hrs	@	=	———
Mechanical tamper operators	hrs	@	=	———
Carry forward				$
___% Insurance, social security, taxes, etc.				———
% Profit and overhead				———
Sub-total labor				$———
Sub-total labor				$———
Total replacement of unsuitable backfill				$———

Temporary Pavement (k)

Will a temporary pavement be necessary?

Will this be gravel, oiled gravel, waterbound macadam, penetration macadam or bituminous concrete?

Is the contractor subject to maintaining the temporary pavement?

Permanent Pavement (l)

Will a permanent pavement be required?

How long will it be before the permanent pavement can be replaced?

What type of pavement will be required?

Cost Estimate for Permanent Pavement

	hrs	@	=	———
	days	@	=	———
	hrs	@	=	———
	days	@	=	———
	days	@	=	———
Carry forward				$
___% Profit and overhead				———
Sub-total equipment				$———

	c.y.	@	=	———
	gals	@	=	———
	tons	@	=	———
	c.y.	@	=	———
Carry forward				$
___% Profit and overhead				———
Sub-total materials				$———

	hrs	@	=	———
	hrs	@	=	———
	hrs	@	=	———
	days	@	=	———
	hrs	@	=	———
	hrs	@	=	———
Carry forward				$
___% Insurance, social security, taxes				———
___% Profit and overhead				———
Sub-total labor				$———
Total permanent				$———

(This article may not be reprinted without the authority of the author.— **Editor)**

Book Review

"Laboratory Manual in Soil Mechanics," by Raymond F. Dawson, Professor of Civil Engineering, University of Texas, has just been published by the Pittman Publishing Company, New York, N. Y. 177 pages of text and 57 pages of laboratory forms. Pages are 8½" x 11". Price, $3.25.

This manual is made up from notes originally prepared for use in the author's laboratory classes in soil mechanics. Many of the tests follow the standard methods prescribed by the A.S.T.M. and the A.A.S.H.O. These, however, have been enlarged and explained in enough detail for the student to be better able to grasp the objectives of the tests.

Description of the tests follows a uniform pattern as follows:

Description of test, references, apparatus, description of testing device, preparation of sample, testing of sample, calculation of data, comments on test. Line drawings, charts, tables, and curves fully illustrate the text. Prof. Dawson, in this work, has made a valuable contribution to the art of soils investigation. The 57 pages of laboratory forms at the back of the paper bound volume are a distinct advantage to the laboratory technician.

Airport Construction—A 47% increase in funds for airport construction for fiscal year 1950 is provided in the bill passed by Congress on Oct. 20. The total appropriation is $39,815,213 as compared with $27,000,000 for the previous year. The funds are apportioned to the states by CAA on a 75-25 basis.

Uphill Truck Speeds

(*Continued from page 63*)

tion with the portion above the 25 mph. line. If a 5% grade is longer than 1500 ft., or a 6% grade is longer than 1000 ft., then some design provisions must be made to allow room for the slow trucks to move over and provide access for the higher speed vehicles to pass without undue congestion and resultant loss of time.

It was also noted that the rate of change of the slope of the lines for the different percentages of grades was quite rapid until a 4% grade was reached. At this point the change to a 5%; 6% and 7% was greatly reduced. It has been said in highway location and design if a certain difference in up hill elevation is to be made and that if the percent of grade is over 3% then it is most economical to go immediately to a 6% and make the difference in elevation in the shortest possible distance. We can now consider amending this somewhat basic concept and say that a 4% grade can probably be considered instead of a 3% grade as previously stated.

Several interesting side lights were noted during this survey and included these observations:

(a) As nearly as could be determined with the instruments at hand and technique applied, there was no great difference in performance of heavy vehicles at elevations from sea level to over 7000 ft. One reason for this is the great reserve of power usually associated with the diesel trucks, however, this observation was made between vehicles in the same power group of around 150 hp.

(b) It had previously been rumored that overheating of heavy trucks limited their performance on mountain grades. During the course of this survey it was found that all trucks in good mechanical condition had no trouble with overheating.

(c) Individual driver habits were quite important. An experienced driver traveling over a known route and shifting gears at just the right time could travel a greater distance up a given grade before reaching the crawl speed than could a driver with less experience.

Copies of the complete report may be obtained by writing a letter to W. C. Lefebvre, State Highway Engineer, Arizona Highway Department, 1701 West Jackson Street, Phoenix, Arizona.

Acknowledgments

The interest, spirit of cooperation and helpful suggestions of individuals and organizations both within and outside the Arizona state highway department have helped toward the successful completion of this work. A great deal of credit is due O. K. Normann and Carl Saal, highway engineers of the Bureau of Public Roads. Their worthwhile suggestions and criticisms were of great value in compiling this report.

Credit is also due to all operators of the surveyed vehicles and to several dealers who furnished manufacturers' data, not available at the time of survey. Without this cooperation and interest on the part of the trucking companies throughout Arizona and the Southwest, much of this work would have been impossible.

Joint Venture Bids Acceptable to N.J. Turnpike

The New Jersey Turnpike Authority will accept bids on its projects from two or more contractors on a joint basis, subject to certain conditions, according to an Authority ruling. Large rush jobs are in the offing on this project.

Joint venture bidders must first be individually prequalified in the prescribed manner, in an amount equal to the sum of all prequalified bidders in the venture. An exception is where the assets or liabilities of two or more of venture members are interlocking, or where there is other reason why the sum of the prequalified amounts of the members should be reduced.

Prequalification of a joint venture will be made by the Turnpike Authority if desired by the joint venture. For this purpose a joint statement, in the form prescribed by the Turnpike Authority for individual bidders, must be received by the Authority not less than 12 days prior to the final day for bid submission.

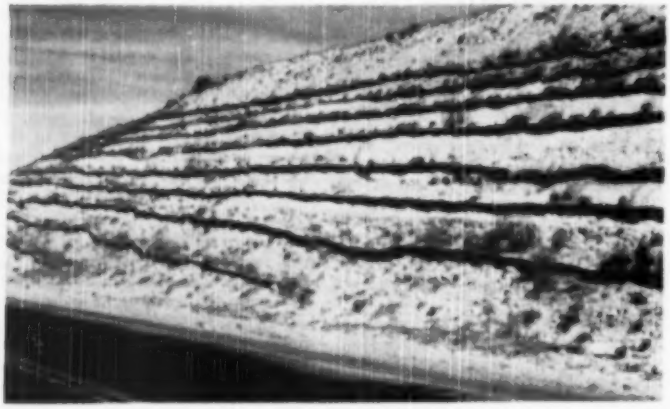
In the event prequalification of a joint venture is not requested, or not made prior to the opening of bids, the bid will be accepted and considered provided its members have been prequalified as prescribed by the Turnpike Authority. In such circumstances, and in the event that the joint venture submits the low bid, the Turnpike Authority reserves the right to determine whether the bid is within the class in which the joint venture should be qualified, and to reject the bid if circumstances, in its judgment, so warrant.

●

Locking of cable connectors on battery terminals by corrosion is minimized by the simple expedient of using cloth washers saturated with petroleum or light grease under the battery connectors. The method was devised by an Army mechanic at Fort MacArthur, California.

One Way to Stop Erosion

Old fence wire, cut up into strips and set in position as shown in the accompanying photo, successfully ended erosion problems in a large cut in the Texas panhandle. The climate here is arid, and growth of a cover of any kind virtually out of the question. The strips of wire are held down by rows of stakes.



In commenting on this picture G. B. Finley, maintenance engineer, Texas highway department, wrote as follows:

"I was over this highway last week with District Engineer Lott, and we commented on this work. I ask Mr. Lott how it was doing, and he said that this type of work was doing an excellent job and was keeping this cut from eroding. We both admitted that it did not look any too grand, but if these barriers keep the hill from washing that is what we want. We agreed that it looked like this was the best thing that could be done under the circumstances. We had the old wire and, naturally, the cost is reduced by using secondhand material."

Bituminous
ROADS AND STREETS

JANUARY, 1939

County Road Program. Road here is the black-topping over a Ingham County, Mich., three county-wide highway resurfacing program is described in the following pages

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Asphalt Department

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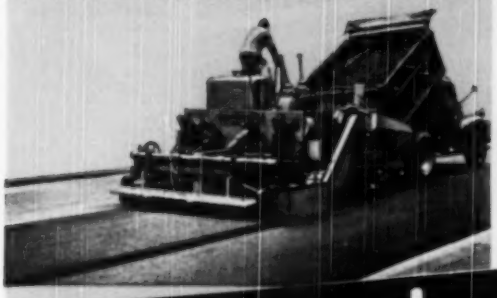

New Paver-Type Aggregate Spreader, first low cost, self-propelled spreader that operates entirely on the subgrade, accurately lays all base and surface aggregates, plant-mixed stabilized soil and free-flowing bituminous mixtures up to 12½' (25' in tandem).

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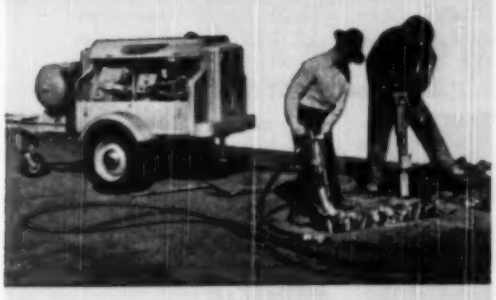

"Air Plus" Compressors in new standard sizes (75 to 600 ft.) that do 4 days' work in 3 with the same men and tools.

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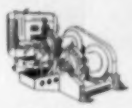
"Speedline" Mixers
More mixing action, advanced construction in 1950 models.



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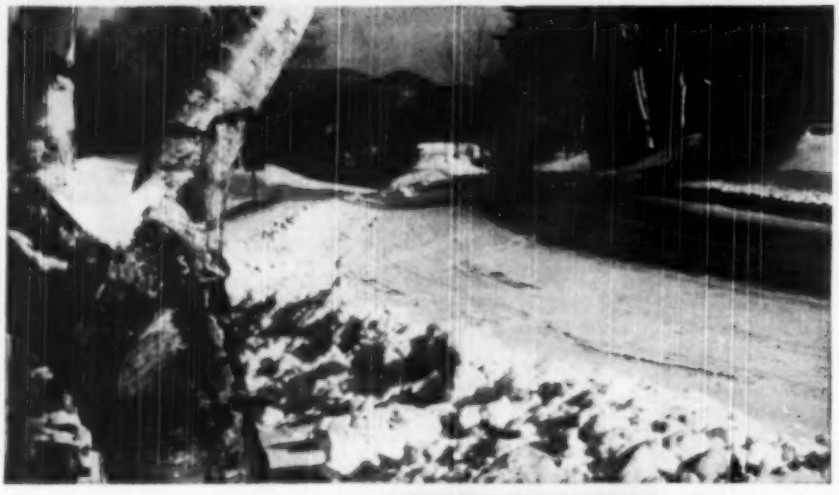

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★ Ingham County's Pioneer hot-mix plant and Koehring dragline working pit 4

Pit-Gravel Hot-Mix

Basis for This Economical County Road Program

Using carefully selected pit materials, a modern portable hot-mix plant, and latest type bituminous paving equipment, Ingham County, Michigan, black-topped 65 miles of roads in 1949. Methods and cost data herewith

By Frank K. Evans

Engineer-Superintendent, Ingham County Road Commission, Mason, Michigan

INGHAM County is located in south central Michigan. Its largest city is Lansing, the State Capital. Total population is approximately 150,000 and the assessed valuation is close to 240 million dollars.

The topography and climate are typical for most north central states; land is flat to gently rolling with considerable swamp area. The central and northern portions of the county are predominated by quite heavy soils and fairly high water tables. The southern portion of the county has from light to sandy soils, which are well drained. Local deposits of gravel are well distributed in glacial deposits and for the most part are a sandy type of gravel.

Our county road system of about 1140 miles is made up as follows:

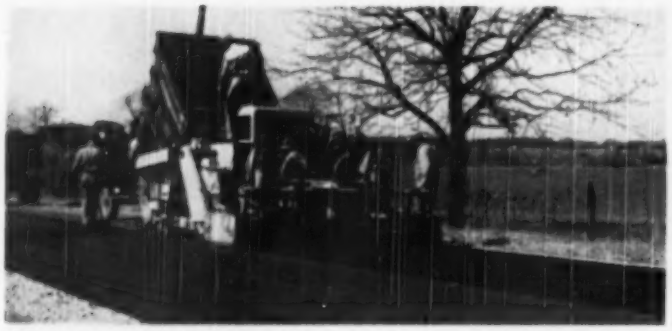
Type Roads	Black Top Surface	Gravel Surface
County primary	346 miles	24 miles
County local	158 miles	468 miles
Sub-division streets	35 miles	105 miles

Wholesale Frost Damage

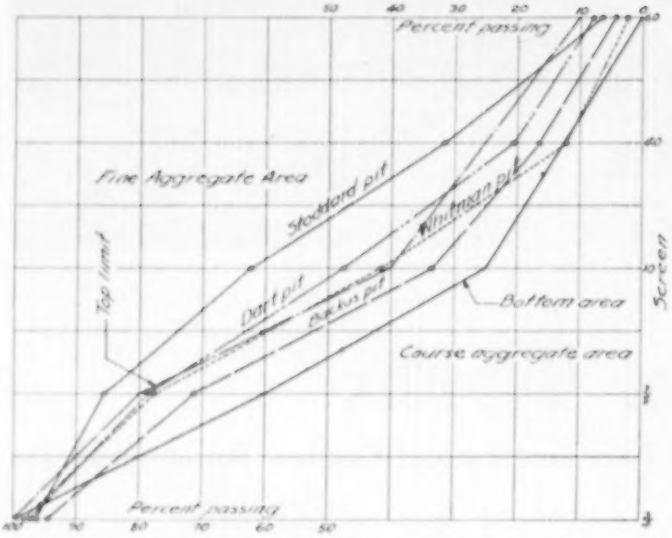
During the spring months of 1948 this system of roads was subjected to the most severe and damaging break-up conditions in the history of this section of Michigan. Surveys carried on during the break-up period, and immediately after all frost had left the ground, revealed that some eighty miles of bituminous surfaced roads had been completely destroyed or damaged beyond repair.

Prior to World War II, for a period of about twelve years, this county had practiced the policy of constructing an extensive mileage of low-cost bituminous roads. The type of dust-proof surface built was extremely popular and the pressures by a demanding public necessitated lowering our standards of base construction to a dangerous level. The severe frost condition in the spring of 1948 was, "the straw that broke the camel's back."

Primarily, we were engaged in "plowing under" the remains of destroyed bituminous surfaces for the remainder of 1948. The old surfaces were scarified, broken up and used as base material. In all cases, an additional three to four inches of gravel was added to the roadbed and where needed sand sub-bases were placed to an average depth of 12 in. In 1948



★ The County's Jaeger bituminous spreader on surface course



we were able to completely reconstruct, with adequate bases and bituminous surface, 8½ miles of road. An additional 32 miles of surface were patched and then re-capped with a 2-in. depth of hot-mix. Nine miles of surface were temporarily patched and some 31 miles were reverted to gravel surface.

Large 1949 Program

The problem to be solved in 1949 was obviously the complete restoration of all primary county roads, with as much restoration of surfaces as possible on secondary roads. Normal replacement of worn-out black-top surfaces will average over thirty miles annually in this county. A final program for 1949 was recommended and approved which called for placing slightly over 65 miles of bituminous mats as well as seal-coating an additional 75 miles of the existing bituminous roads.

The problem of financing this program was impossible with our normal revenues which are entirely derived from state sources. Local authorities —that is the county, city and township units—were presented with our problem and agreed to provide additional financial assistance of almost $250,000. These local funds were provided purely as an emergency measure.

The winter months of 1948-49 were devoted to preparations and planning in order that our 1949 work program, which was to be done by force account, would progress on an orderly smooth schedule. Preparation of bases was carried on throughout the winter and adequate stockpiles of aggregates produced at convenient locations. Equipment was thoroughly overhauled and standby units purchased where necessary.

A plentiful supply of gravel in the county dictated the use of this local material as our aggregate. All gravel used in our mixes is processed through a plant. We merely crush the oversize stone to ¾ in. maximum size. Stockpiles of dense graded aggregate were erected at locations so that average haul distances of 6 or 7 miles were possible. Our average cost of this material in stockpile was slightly under 40c per ton.

By early spring we had available in stockpiles, at four gravel pits conveniently located for black-top operations, about 102,000 tons of aggregate. The stocks were specifically earmarked for our black-top program and were as follows:

Dort Pit No. 1	30,000 tons
Whitman Pit No. 2	45,000 tons
Stoddard Pit No. 3	15,000 tons
Bacon Pit No. 4	12,000 tons

Mechanical analysis was shown in Table 1.

Method of Mix Design

Our choice of bituminous materials was made by the practical method of preparing sample mixes of various bituminous materials with the aggregates to be used. Small bricks were prepared from each mix and these bricks were closely examined for the qualities which we wanted in our final product. This examination plus past experience led us to choose materials and percentages to be used on the jobs as shown in Table 2.

Samples of the asphalts used are taken from the tank cars and sent to Walter Flood or the Chicago Testing Laboratories for standard tests to determine compliance with Michigan specifications.

Moisture tests on the aggregates

Table 1—Mechanical Analysis

Gradation	Pit #1	Pit #2	Pit #3	Pit #4
Passing ⅜"	97.8%	98.9%	96.4%	94.8%
Passing ¼"	79.6%	76.1%	85.9%	71.7%
Passing #10	47.4%	41.7%	62.2%	33.4%
Passing #40	19.2%	17.0%	31.4%	16.1%
Passing #80	8.0%	8.9%	6.5%	4.1%

Table 2—Percentage of Bitumen*

Material	Pit #1	Pit #2	Pit #3	Pit #4
Slow curing liquid asphalt	5.5%	5.5%	4.3%	——
S.O.A. asphalt cement (100-120)	——	4.5%	——	——
MC-5 medium cut back	——	4.5%	——	4.5%
Tar—(T-10)	——	——	——	4.5%

*Note: percentage of bitumen was actual residual bitumen (solvents omitted) by weight to weight of aggregate.

are performed at the mixing plant by our inspector who has a portable stove, screens, scales, pans, etc., for this type of testing. Standard ASTM methods are used. Extraction tests are run in our laboratory using a hand-operated extractor (centrifuge); ASTM standard test procedure.

In checking our practical designs of mixes we find them to hit very close to the surface-area method of design for percents of bitumen.

Our extraction tests show us to be generally on the light side of our mix; however, the running of an exact extraction of asphalt in a mix is very difficult and I believe from physical inspection that some of these extractions did not fully remove all asphalt.

★ Modern trucks help Ingham County keep costs down. Chevrolets seen here loading hot-mix

Equipment Used

Pioneer Model 30 hot-mix plant, complete with Pioneer drier
Koehring ¾-cu. yd. dragline, Model 304
Michigan shovel ½-cu. yd. Model TMTD
Standard bituminous distributor—semi-trailer, 2200-gal.
Cleaver-Brooks tank car heater
Jaeger bituminous paver, Model BP-5
Barber-Greene bituminous paver, Model D
Galion tandem roller, model 12T
Dump trucks (4-yd.) 14 to 16, county owned

Job Operating Procedures

Bituminous material for use in the hot-mix plant is received by rail delivery and is ordered in insulated tank cars. No storage is available either at the rail head or the plant. Asphalt is heated in the tank car with the tank car heater and hauled direct to the hot-mix plant by the 2200 gal. distributor. Hot asphalt is pumped into a 1600-gal. insulated tank at the mix plant and then pumped direct to the mixing plant. Aggregates are fed into the feed hopper to the drier by a ¾-yd. dragline from our stockpile. Our hot elevator is a conveyor using high-temperature rubber belting. We load out hot mix direct from the continuous flow pug-mill to our haul trucks for delivery to the paving site, where trucks are dumped into the bituminous paver for laying.

Rolling of the mat is commenced as soon as possible. Immediately after rolling the road is opened to light vehicular traffic.

Inspection Notes

We provided a fair degree of inspection during 1949 on this force-account work, particularly at the plant. Plant settings were checked twice daily, covering both the feeder gates and bituminous pump to the pug-mill. Moisture tests were run on gravel in the stockpile and gravel entering the pug-mill at least twice a day. Samples of the hot-mix material were taken both morning and afternoon and extraction tests were run to determine the actual bitumen in our mix. All mats were laid to a chalk line set ahead of the paver to assure an edge fairly free of any wavers.

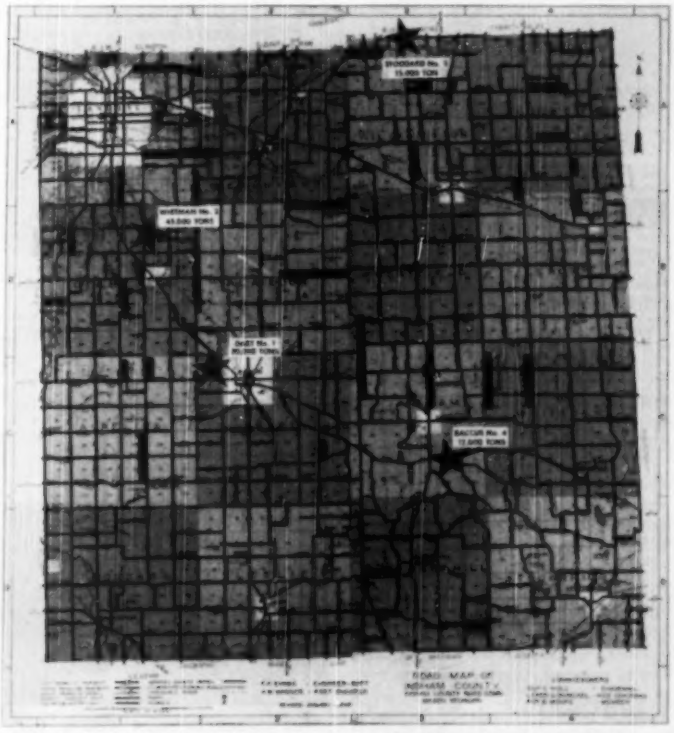
Progress of Work

An exceptionally early spring enabled us to start up our plant on April 25, and paving operations were commenced then. This date is at least a month earlier than normal for this section of the country. Our first set was in Pit No. 1 near the county seat. Approximately 16 miles of mat was laid with a 20-ft. width and 2¼-in. compacted thickness. This set was completed on May 25.

The mixing plant was then moved to Pit No. 2 near Lansing. Paving operations commenced June 12. Approximately 15 miles of streets and roads were paved with 2¼-in. compacted mats varying in width from 20 to 30 ft. This operation was completed on July 13.

The plant was moved to pit No. 3 on our north county line. Operations here began August 3, completed August 16. About 10 miles of 20'x2¼" compacted mat was laid from here.

Operations began August 25 at pit



★ Showing how the 65 miles of 1949 resurfacing was scattered through Ingham County

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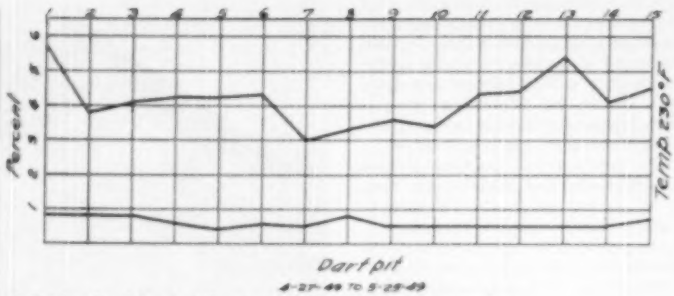
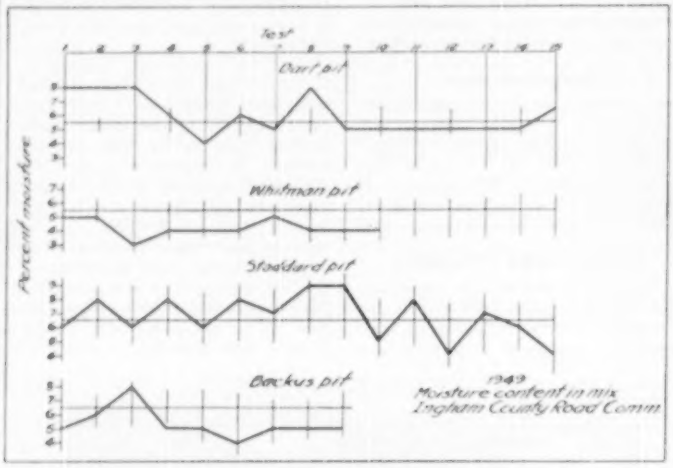


★ Results of moisture tests from one pit—before and after processing



★ Moisture content in typical samples from each of the four county pits

SUMMARY OF MIXING OPERATIONS

	Pit 1	Pit 2	Pit 3	Pit 4
Hot mix cost/ton at plant	$2.24	$2.62	$2.98	$3.50
Tons processed	20,211	33,860	10,727	10,779
Moisture in stockpile	4.1%	4.0%	5.0%	4.9%
Moisture after drying	0.5%	0.4%	0.7%	0.4%
Temperature of aggregate	230°	230°	245°	240°
Tons dried per hour	90-100	90-100	90±	90±
Plant setting, tons/hr.	125	125	125	125
*Bitumen in mix (extraction)	3.5%	3.7%	4.2%	
MC-5 (extraction)	——	4.4%	——	4.4%
T-10 (design)	——	——	——	4.8%
S.O.A. (extraction)	——	3.9%	——	——

*Majority of mix was liquid asphalt, plant was operated in same ranges for MC-5 asphalt and T-10 tar. Asphalt cement (S.O.A.) mixed at 340°F with aggregate bone dry at 350°F. Capacity of drier dropped at 80+ tons/hr. at 350°.

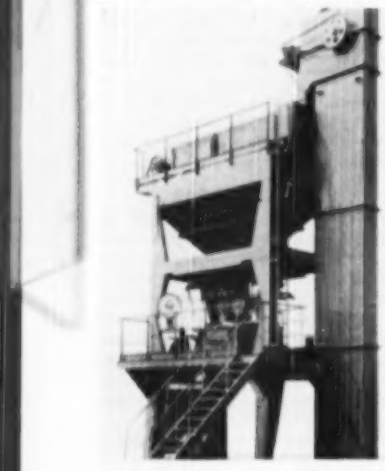
No. 4, located south of Dansville and were completed on September 13. Some ten miles of MC-5 and tar mixes were laid during this period.

The fifth and last move for the plant was made on September 14, when it was moved back to Pit No. 2. Operations began September 22; were completed at the end of our season, October 20. Fifteen miles of road were paved.

A total of 66 miles of surfacing had been laid during the season.

During the periods when paving was not in progress (during plant moves, etc.) we carried on our regular program of placing bituminous seal coats

(*Continued on page 77*)



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(Continued from page 76)

on older black-top sections. The paving crew trucks, distributor and roller were swung over to this operation. The 75 miles of seal coat was placed between May 25 and September 22. Asphalt emulsion applied at 0.4 gal. per sq. yd. with 20 lb. per sq. yd. of pea stone cover describes our average seal.

Hours of plant operation: 961, total tons mixed: 75,576. Hours of paver operation: Jaeger BP-5, 529 hrs.; Barber-Greene, 352 hrs. Fuel oil consumption (dryer): 106,614 gal., total, or 1.4 gal./ton.

Notes on Costs

The availability of a cheap gravel aggregate for our mixes accounts to a considerable degree for the low cost figures of our mix. Our cost for gravel ranged from 30c per ton in Pit No. 1 to a maximum of 50c per ton in Pit No. 4.

Our hourly equipment rental rates used in computing costs are as follows:

Hot-mix plant with dryer	$48.00
⅝-yd. dragline (feeding plant)	2.51
½-yd. truck shovel (for stock pile)	3.38
2200 gal. distributor	3.27
Tank car heater	1.53
Bituminous pavers	8.00
12-ton roller	1.53
3-yd. dump trucks	1.05
4-yd. dump trucks	1.61

The rental rates pay for equipment depreciation, repairs, operating costs, insurance and housing. These rates do not include operators.

Hourly wage rates:

Labor	0.90 to 1.05/Hr.
Equipment Operators	1.15-1.45/Hr.
Blacktop foreman	1.45/Hr.

Costs from 2 typical jobs:

(a) Aurelius Road—2 miles of 20'-20' Average haul—8 miles. Pit No. 1	
24,000 sq. yd.—Total cost	$7910.00
Paving labor	$ 618.84
Bituminous mix (labor-material-equip.)	5760.00
Paving equipment (hauling-laying)	799.24
	$7178.08
Administrative & overhead—10%*	717.81
Total cost	7895.89
Cost per mile	3947.95
Cost per sq. yd.	0.33
(b) Pennsylvania Avenue—1½ mi.—asphalt cement (S.O.A.) 20,000 sq. yd. of 2½"-22' mat; Pit No. 2; haul 2 mi. No tack coat—prime and seal (done in Fall of 1948)	
Paving labor	$1006.91
Paving—equipment rental	1004.96
Bituminous mix (labor, material and equipment)	5411.25
	7423.12
Administrative & overhead 10%	742.31
Total cost	$8165.43
Cost per sq. yd.	0.41

* Note our overhead includes compensation insurance; all office expense and administrative salaries were 9.5% in 1948.

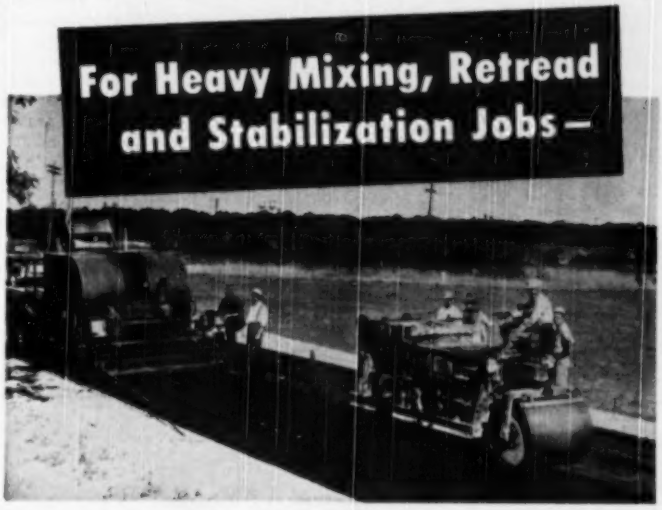
Adapting to the Mix

Slow-curing liquid asphalt of light or medium grade was used exclusively in Pit No. 1 and Pit No. 3. In Pit No. 2 the liquid asphalts were used with the exception of 120 tons of asphalt cement and 40,000 gal. of MC-5 asphalt. For our dense graded aggregates we have excellent results with liquid asphalt.

In Pit No. 4 which had a fairly open grading we used only T-10 tar or MC-5 asphalt, these materials gave us a much faster set on the mat. Pit No. 3 which had a very poor grade aggregate gave us good results on light traffic roads, but I doubt that these mats could stand much heavy traffic. We hope to get a life of 12 to 15 years from these mats.

Our principal bottle-neck in operations was in our drier unit. The capacity of the drier was about 20% less than that of the mixing plant. Two features of our drying unit have been particularly pleasing: the burner which is a Ray-Electric self-atomizing unit which eliminates the need of steam for atomization. This burner has operated two seasons for us without showing any mechanical defect.

After two seasons of operation we can observe no apparent distress on our hot aggregate conveyor belt which has high-temperature rubber. This belt has been subjected to temperatures of 350° F. without showing signs of trouble.



The New Heavy-Duty Moto-Paver

Although developed primarily to meet the rugged conditions of hilly and mountainous terrain, the heavy duty Moto-Paver is proving equally efficient under widely differing conditions in other sections of the country.

Wherever you have a heavy bituminous mixing, retread or stabilization job, it will pay you to investigate this new and more powerful Moto-Paver. It does the *complete mixing* and *laying job—in one continuous operation.* See your local distributor or write direct for specifications and complete information.

The Moto-Paver is a very flexible as well as a mobile unit. The illustration shows it being used as a stationary mixing plant.

H&B

Hetherington & Berner Inc.

721 KENTUCKY AVENUE, INDIANAPOLIS 7, INDIANA

Because of its newness on the market considerable interest was shown in our Jaeger Bituminous Paver Model BP-5, purchased in May. We have been well pleased with the performance of this machine, both mechanically and in the quality of mats that it has laid.

We roll our mats with a Galion 12-ton tandem roller. On some slow-curing asphalt jobs where the temperature of mix remained quite high in the mat we often found it desirable to give the mat an additional single rolling the day after placing. This seemed to prevent some tendency of the mat to rut under medium loads.

●

Carolinas Branch, Associated General Contractors of America has elected N. K. Dickerson, Jr., of Monroe, N.C., as branch president; H. S. Crain of Durham, N.C., vice-president; C. P. Street of Charlotte, N.C., treasurer, and Robert Patten of Charlotte, executive secretary, the latter two being re-elected.

Mr. Patten reported that the branch's members contributed $38,000 in the past year toward a construction endowment for North Carolina State College at Raleigh and raised $24,000 for apprentice training projects in Charlotte, Greensboro, Raleigh and Durham, all in North Carolina. Branch headquarters is located in Charlotte.

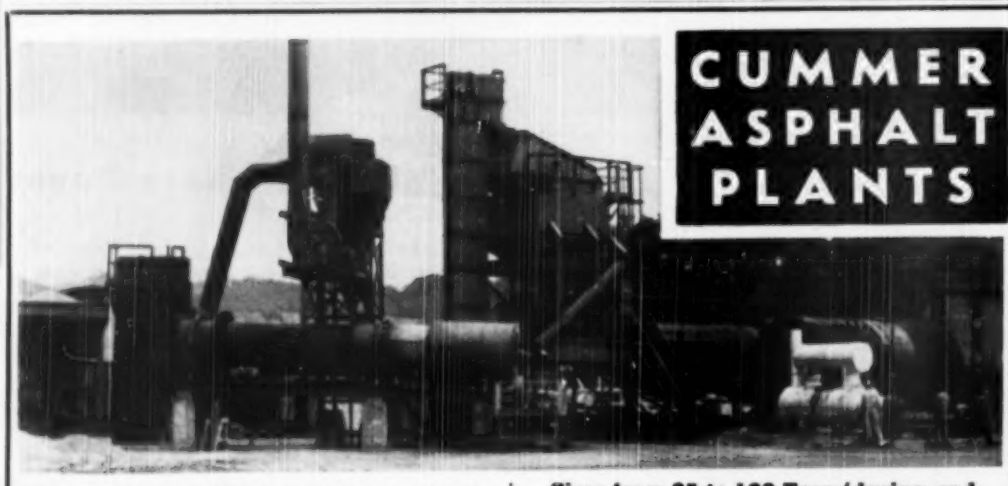
A Few Fundamentals of Low Cost Road Design

Reprinted with permission from The Asphalt Institute Quarterly

THE chief highway problem everywhere is that of stretching available road construction funds over the largest possible mileage consistent with good results. Two fundamentals of road design must be observed to achieve the economy so necessary. The first is, *drainage*. The second is, *proper foundation*. Without these the best alignment and easiest grades are of no little avail. With them, a road can wind over hill and dale, and still give useful service every day of the year. Tolerances for curvature and grade, therefore, should be established for the kind and amount of traffic expected. In localities where the road-use pattern has become well established, it isn't necessary to anticipate the future very far ahead.

This point is emphasized because there has been a tendency toward *unnecessarily high design standards*, particularly on some lightly traveled sections in the state and federal arterial highway programs. This tendency is believed to add markedly to cost without bringing commensurate return. Of course where low cost surfaces are placed on *primary* routes, the same attention to new right-of-way, surveys, and records is required as for high type pavements. For the distinctly local roads, however, a reasonable amount of right-of-way usually sufficed, and it is possible so to modify the alignment within these limits as to meet all real needs.

In view of the fact that many roads do not have now, or are unlikely to have, as much traffic as even 200 vehicles per mile per day, it can be seen readily that not only must the surfaces be built at low cost, but all the incidental items must be proportionately low, if a well rounded improvement is to be attained.



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Cleveland 15, Ohio USA

Cancelling "Holidays" in a COATING'S CALENDAR

Look closely at the picture above, and you'll see a spark jumping from the metal test panel to the electrode in the technician's left hand.

That means the coating on the panel is not in a continuous film or is broken . . . protection thereby is not complete. We say the coating has a "holiday" in it.

Sometimes these "holidays" aren't visible to the naked eye. So Flintkote researchers use this method of testing electrically to be *certain* that the coatings tested meet the conditions for which they were formulated. When the tell-tale spark appears . . . back the coating goes for further development until it passes every test with flying colors.

And this is only one of literally hundreds of painstaking tests that Flintkote researchers make on every product. Housed in one of the most modern, efficiently equipped buildings in the industry, the staff of this new research laboratory sets the pace for Flintkote plants from coast to coast . . . to assure better products and better results consistent with lowest possible costs.

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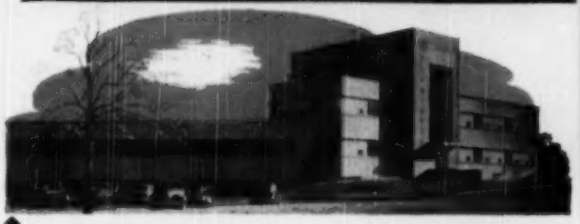
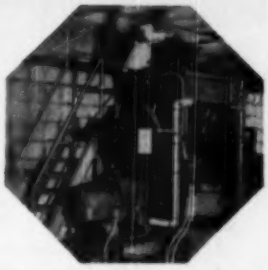


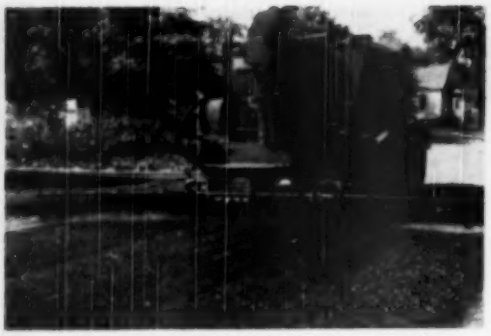
↑ One or more of 24 separate laboratories constantly evaluate Flintkote products step by step from raw materials to field performance, from initial development to mass production. Both Company and Customers profit by this *insurance from research*.



This "pilot scale" ribbon type mixer ➡ enables the laboratory to reproduce production conditions quickly and accurately for research and testing of a variety of asphalt mastics.

⬅ Scientific equipment in use here permits complete analyses when only minute quantities, sometimes no larger than a pinhead, are available. Techniques like this assure purity, reduce cost, speed operation and increase accuracy in the Flintkote Laboratories.

This small scale rubber mill is used to ➡ break down various rubber materials to just the right consistency for use in new products or processes. Full size operation follows in the production of versatile fluid rubber and rubber-like adhesives, coatings and sealers.



★ Outlying suburban streets as well as roads can often be improved at low cost per mile by sensible grading, light gravelling and seal coating. (Above and succeeding scenes show steps in Kent County, Mich., suburban road procedure)

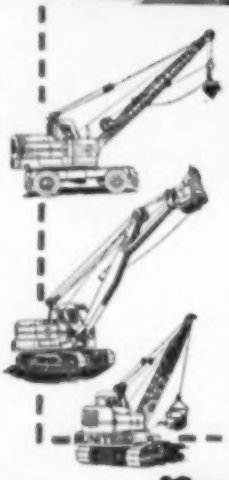
Surveys and Plans

For the field work a three-man survey party usually can run a satisfactory line by eye, with only such reference points and notes as will indicate drainage, buildings, fences and principal obstacles. Grade stakes can be set at 50-ft. intervals at the time of the survey, and the necessary cross-sections taken. For the office work, a simple profile and cross-sections are usually sufficient. Record alignment plans are seldom needed for the very light traffic roads.

The new grade should be established involving minimum earthwork, *yet consistent with keeping the roadbed well above the water-table.* It is far better to roll the grade over a small hill and retain good drainage, than to make a cut for the sake of a nicer looking slope on paper, and later find a soft spot in the actual road. To fill the low sections, it is usually more desirable to borrow selected soil, than to try to balance cut and fill within the road limits. Every possible inherent load support value, brought about over the years, should be conserved and added to with new good material, rather than wastefully destroyed.

It is really astonishing what economies can be effected, provided non-essential standards for alignment and grade are not required; and yet over and over again we find surveys, plans and records being made for light traffic that would suffice for twenty times the volume. As a matter of fact, a rolling, winding road is usually not only easier to drain but also, as speeds are lower, safer for travel.

A recent visit to a number of U.S. roads, first improved in 1912 and following the methods outlined, indicates the soundness of this simplified approach to surveys and plans. Except for subsequent surface treatment, and



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★ Reshaping a low cost road, preparatory to adding 4 in. of new gravel layer and surface treating

in some instances mixed-in-place wearing courses, the original macadam and gravel foundations are unchanged from the original construction. To be sure, they are still light traffic roads but so are over two-thirds of all the highways in the entire country.

Low-Cost Materials

Low-cost roads of necessity must employ low-cost materials. That means materials from nearby points, particularly for foundations. Whatever they are, these aggregates should have a certain basic characteristic; namely, that when placed as foundations, bearing power shall be reduced little or none by *changing moisture conditions*. This is an easy matter to check, but one which is all too frequently neglected.

It is such a temptation to select an aggregate which will compact easily, that the damaging effect of too much clay binder is often overlooked, only to cause a lot of trouble later. By following standard methods of soil analysis, and using aggregate where the fine material does not show a Plasticity Index (P.I.) of more than 6, one can be quite sure that the foundation once compacted will remain that way. If the only abundant natural materials available have a P.I. higher than 6, then they should be modified, at

★ New base gravel being spread

Rollers produced by Buffalo-Springfield, the world's oldest and largest exclusive roller manufacturer, are recognized as "the standard of comparison" by the construction industry throughout the world. Experience from nearly sixty years of exclusive roller manufacturing goes into the designing and building of each Buffalo-Springfield roller.

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THE STANDARD OF COMPARISON
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Athey FORCE-FEED LOADER-PORTABLE BREAKER PLANT "Buys itself," crushing 35 mi. of gravel road

— for Malheur County, Oregon!

This Athey Force-Feed Loader and Portable Breaker Plant is picking-up windrow oversize pit-run gravel, crushing it and depositing it back on the road surface in a single operation—for secondary road resurfacing.

This equipment works directly from windrows made from original road surfacing with necessary added pit-run gravel.

Operating about 6 hours daily, Malheur County's Athey Force-Feed Loader-Portable Breaker Package crushes 100 cubic yards of pit-run gravel, hourly. That means preparing the gravel to resurface over one-half mile per day.

"Our Athey outfit has paid for itself while crushing pit-run gravel for resurfacing 35 miles of secondary road," reports Malheur County's commissioners. (This is compared to gravel crushed by stationary plant.)

The Athey Force-Feed Loader-Portable Breaker Plant is proving to be an enormous money-saver—in the reworking of gravel, rock, bituminous and other surfaces.

Your Athey-"Caterpillar" Dealer will supply you complete information on this streamlined method—without obligation.

ATHEY PRODUCTS CORPORATION
Chicago 38, Illinois

Athey APCOR Products

Athey PORTABLE BREAKER

★ Blading new gravel to final crown

least in the surface, through appropriate treatment, such as the addition of fine granular aggregate, treatment with lime, or stabilization with liquid asphaltic materials, until the resulting mixture is definitely reduced in P.I. below the danger point. Much research is being carried on in this field, and specifications for appropriate procedures are widely available.

There will always be a large mileage of local roads where surfacing cannot be justified beyond placement of such aggregate as will assure all-year support. When traffic reaches around 50 motor vehicles per day, however, further improvement becomes practicable, as the cost of maintenance, plus the loss of aggregate through wind and water erosion, usually amount to a sum sufficient to capitalize a mudless, dustless surface.

★ Sprinkling gravelly base materials in conjunction with use of pneumatic roller

Black-Top Maintenance Costs

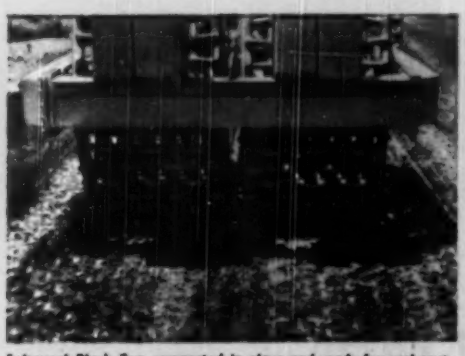
Residential streets paved with black-top are less expensive to maintain than are gravel roads, officials of Lansing, Michigan, have found. While maintenance costs for gravel streets in that city range from $600 to $1,000 per mile, black-top bituminous street upkeep costs average only $100 per mile. A low-cost surfacing is used only on streets carrying less than 4,000 vehicles per day.

Revolutionizes Black Top Salvage Jobs

HOW IT WORKS...WHAT IT DOES

1. Black top is scarified by motor grader pulling Grid Roller.
2. Scarified black top is pulverized to a maximum of small "fines" by Grid Roller.
3. Pulverized black top is windrowed—road bed cleaned by motor grader—compacted by Grid Roller.
4. Windrow is spread and oil applied, material mixed and relaid and then compacted by Grid Roller. Now ready for seal coat.

HOW IT SAVES TIME AND MATERIAL



Salvaged Black Top compacted in place and ready for seal coat

1. In ONE day ONE man with motor grader and Grid Roller can salvage and prepare ONE MILE of black top road for oiling.
2. Grid Roller produces greater abundance of FINE MATERIAL.
3. Oil usage reduced up to ¾ of a gallon per cubic yard—on one county road job a savings of $343 per mile in oil was effected.
4. Grid Roller salvages all types of black top material. NO NEED TO HAUL AWAY OLD MATERIAL.

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Gray, Grayson Elected to Head Asphalt Institute

Bernard E. Gray has been elected president of the Asphalt Institute and Inghram Grayson, Lion Oil Co., has been elected chairman of the executive committee, according to an institute announcement.

Members of the executive committee include N. H. Angell, Stancal Asphalt & Bitumuls Co.; J. N. Byrd, Mexican Petroleum Corp.; P. C. Doyle, Standard Oil Co. (Ohio); H. B. Pullar, Berry Asphalt Co.; R. S. Ketcham, Col-Tex Refining Co.; Harold R. Pauley, Petrol Corp., and Mr. Gray.

Byrd has been named vice president for Division I (Atlantic-Gulf); Doyle heads Division II (Ohio-Great Lakes); Pullar, Division III (Mid-West); Ketcham, Division IV (Southwest), and Pauley, Division V (Pacific Coast).

Herbert Spencer was re-elected secretary of the institute; George R. Christie, Socony-Vacuum Oil Co., was re-elected treasurer, and John N. Smith, also of Socony, assistant treasurer.

American Bitumuls Co., San Francisco, and Cosden Petroleum Corp., Big Spring, Tex., were elected to membership in the Institute.

Montana Road Base Change May Save State $500,000

Montana may save $500,000 annually on secondary roads as the result of an agreement reached between the bureau of public roads and the state highway department on base construction, State Highway Engineer C. E. Stahl estimates.

The agreement was the result of a recent meeting between state and federal highway officials.

Stahl said the state will spend from six to seven million dollars this year on secondary roads and expects to cut by $500,000 the amount needed to build base courses for that construction. Most of this will be accomplished, Stahl explained, by changing the present gravel layer bound together with clay to a natural soil and gravel or sand mixture.

Stahl predicted not only a saving but a better all-weather surface. He said counties should be able to maintain the surface with their present machinery, which will do much, he added, to eliminate the difficulty which counties have experienced for years in maintaining their secondary highways.

Stahl said another soils meeting is planned for next spring, when possible changes in primary highway base construction will be discussed.

Highway Set by Canada

Work to begin in early spring on cross-country route

Work will begin in early spring on the new Trans-Canada Highway, R. G. Winters, Minister of Reconstruction, told the Parliament recently.

Under the bill now pending, the Federal Government agrees to pay one-half the cost of the construction of the 5,000-mile modern highway, which will traverse all ten provinces from the Atlantic to the Pacific, reaching St. John, Newfoundland in the east and Victoria in the west.

A considerable portion of the highway already has been laid, but the surfacing in many sectors is below standard and will require considerable improvement. The total cost of building the road has been estimated at $300,000,000.

The road will follow the shortest practical route across the country and each province will select the route across its domain in accord with this definition. The road is to be completed in seven years.

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BODY AND HOIST CONSTRUCTION

Photos show PERFECTION No. 354 Special Dump Body and No. 1027 Isa-Draulic Roll-A-Lift mounted on International truck. Length of body 192", width 96", capacity 16 yds. Can be made in various sizes.

On this PERFECTION Body the triangular side braces are placed on the INSIDE of the side plates—permitting the sides to be mounted flush with edges of the platform. This design increases the inside dimension between sides almost one foot, resulting in greater volume capacity. In comparison with bodies having outside braces, this design also has the advantage of permitting the use of a smaller body for any given volume capacity requirement. This reduction in body size may be in height, length or width, as desired.

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FOR ANY TRUCK STANDARD or SPECIAL UNITS IN ALL SIZES - FOR ANY USE

How One City Keeps Its Loaders Busy

★ Large-capacity refuse truck being loaded with one of the Scoopmobiles

ONE of the interesting points which came out of the street maintenance meeting of the recent Public Works Congress, held at Kansas City in October, was the growing use of mechanical loaders by city officials.

Several delegates told of their experiences with loaders, one being J. H. Moorhouse, Superintendent of Public Service, Highland Park, Michigan. Following the above meeting the ROADS AND STREETS editors wrote Mr. Moorhouse asking him to amplify his remarks. Following are excerpts from his reply:

"We have four Scoopmobile machines and use them in many places, particularly for the loading of rubbish in the alley, as shown in the picture. They are a very flexible and easily operated machine. Having but three wheels they are easily turned in the alley, and can be brought at right angle to the side of the truck by setting the truck on an angle, which we do. This machine has done away with the high shoveling of ashes and other rubbish from the ground into a truck. The trucks shown in the picture have 10-yd. bodies (water level) and quite often 12 or 13 yd. loads are carried.

"We also use those machines for loading snow, loading various materials in the public works yards and at the present time we are using some of them for loading leaves on the street. This machine having a wide bucket, 6 ft. to be exact, can push the leaves along the curb until a large pile is made and then scoop them into a truck.

"By the use of the loaders for loading rubbish in the alley, we have not only lightened the work for the men but have increased production. After reducing the cost of operating the machine, including the driver, to labor hours and adding this into the cost of loading, we still find that there is a saving and a much better job done. In the majority of cases barrels or portable containers can be dumped directly into the bucket, as shown in one of the pictures, whereas in the case of hand loading those same containers would be emptied onto the pavement and then shoveled into the truck.

"I could continue to write on my findings of the advantage of those machines in the public works department, but I believe what I have said will be sufficient to give you some idea of their use."

$437,430,400 for Flood Control

Congress has appropriated $635,428,140 for the civil works operations of the Army Corps of Engineers in the fiscal year 1950. The 1949 appropriation was $615,542,200. The 1950 appropriations provide $437,430,400 for flood control and $197,985,690 for river and harbor work. Eighty-one percent of the 1950 appropriation, or $518,581,090, is for new construction.

★ The loader in a Highland Park, Mich., alley, receiving material from a power sweeper and turning to dump into the truck glimpsed in the foreground

TVA's Experience with

Concrete Aggregate

By Oren Reed
Construction Engineer, and
E. A. McDougle
Materials Engineer,
Tennessee Valley Authority, Upper Holston Projects, Elizabethton, Tennessee

THE Tennessee Valley Authority has built many dams, locks, and other major structures on the Tennessee River and its tributaries within recent years. On the main river, it was generally possible to use natural aggregates but it was usually not feasible to use natural sand and gravel for structures on tributary streams because of transportation costs. Therefore, a quarry was opened up near by in those cases and concrete aggregates produced in a crushing and screening plant. Conclusions from this experience are presented in the following brief outline.

Source of Supply—On large projects where a considerable amount of concrete is involved, the source of aggregate supply is of primary importance. It is always desirable to obtain materials which will meet the requirements of the job as economically as possible. It is frequently necessary to explore possible sources well in advance of concreting operations. If a natural deposit of structurally sound sand and gravel is found near the proposed project, aggregate can, no doubt, be processed from this material cheaper than from quarried stone which might be found in the same region.

Manufactured vs. Natural Sand

When natural aggregates are not available, however, it is necessary to manufacture aggregates from quarried stone. The cost of natural aggregates, as a rule, is less than manufactured aggregates but it is necessary to consider the qualities of the two types in order to arrive at a true comparison. Sand, either natural or manufactured, is more costly than coarse aggregate because of the additional equipment and processing required to produce a satisfactory material.

Mix Design—Natural aggregate, because of the particle shape and smooth surface texture, produces a more workable concrete than manufactured sand and stone. For this reason it is necessary to use a greater percentage of sand in a mix containing manufactured aggregates in order to obtain a concrete of suitable workability. A higher cement factor is required as the percentage of sand in the mixture is increased. These factors naturally increase the unit cost of the concrete. It is, therefore, desirable from an economical standpoint to use mixes with as little sand as possible, consistent with a workable, placeable concrete.

With proper equipment and proper workmanship a specific material can be produced from quarried stone to meet a particular mix design. This is seldom possible when reclaiming sand and gravel from natural deposits. It is usually necessary to design and adjust mixes to fit the sizes of material available.

Specific Gravities—Natural aggregates, especially river gravel, usually contain material of varying specific gravities. This requires constant checking and adjusting of the mixes during construction. Manufactured aggregates as a rule have fairly stable specific gravities. Usually natural aggregates are somewhat lighter in weight than manufactured aggregates. In structures such as gravity dams this is a factor of primary importance and is given a great deal of consideration.

Processing Equipment—The type of crushing and screening equipment needed to produce manufactured aggregate is based on the type of rock and the job requirement. At Fontana Dam, built by the TVA on the Little Tennessee River in western North Carolina, the total concrete requirement was nearly 3,000,000 cu. yd. A fast concreting schedule was maintained during construction and a large, well equipped, efficient plant was needed to supply sand and coarse aggregates as required. Cone crushers proved most satisfactory throughout the entire plant for the type of rock (quartzite). Rod mills were used to produce sand. This was the largest plant used by TVA and was capable of producing 750 tons per hour of finished aggregates. This product was in fractional proportions best suited for the mix designs. At TVA's South Holston Project in eastern Tennessee, the concrete requirement will be less than 100,000 cu. yd. Aggregates are being produced on the job by a plant capable of producing only 100 tons per hour.

Air-Entraining Experience

Air-Entrained Concrete—As previously stated, manufactured aggregates present a problem on jobs where workability or ease of handling the concrete is of primary importance. This difficulty has been overcome to some extent on the Upper Holston Projects of TVA by the use of an air-entraining agent in the concrete mix. An air-entraining agent was used on the Watauga Dam project where manufactured aggregates were used and the results were gratifying.

Various methods of placing concrete were used in the different structures. When concrete was placed by pumping through lines up to 800 ft. in length, the air-entraining agent was particularly helpful.

The construction of the bridges and culverts in connection with road relocation in the reservoir area presented a special problem. Concrete for this work was transported from a central mixing plant in open-body dump trucks over rough haul roads up to 12 miles in length. No particular difficulty was experienced with workability of the air-entrained concrete at the forms. Plain concrete, on the other hand, would settle and stick to the truck beds and was extremely hard to dump. The condition of the concrete was also very poor after such hauls due to the segregation of the light and heavy aggregates.

At the South Holston project preliminary surveys indicated that a comparatively large percent of shale was present in the rock from which it was proposed to make concrete aggregate. The average shale content of the combined aggregates was 5%, with a 10% concentration in the sand. Samples of this material were taken and freezing-and-thawing tests run to determine the durability of the concrete. These tests conclusively proved that a satisfactory concrete could be produced with this material, provided an air-entraining agent was used in the mix. These results were gratifying because of the saving in cost of producing this material as compared with the cost of material from other sources.

Conclusions—The use of manufactured aggregates for concrete structures in preference to natural aggregates is a matter of availability and cost. Natural aggregates are, as a rule,

(*Continued on page* 101)

A New Star in the Excavating Field

Another Output Leader in the Bucyrus-Erie Line— the Fast, Smooth, Powerful

51-B

Here's an entirely new 2-yard excavator — the Bucyrus-Erie 51-B! It features the sturdy yet lightweight construction, fast operating speed, simple "full-feel" controls and proven design that mean sustained high output with outstanding economy of operation. It's versatile, too . . . functions with top efficiency as shovel, dragline, crane or clamshell, and has been thoroughly proved in extensive field tests.

Among the 51-B's many important features are wide use of special alloy steels, selectively hardened for strength and long life and anti-friction bearings to minimize power loss and insure concentricity of rotating parts. Clutches of generous size, requiring no adjustment for weather or temperature variations, provide smooth fast action with high operator efficiency. Twin-rope crowd for shovel operation increases digging stability, speed and output while reducing shocks or vibrations and cutting maintenance costs. Independently operated power boom hoist with power controlled cushioned lowering is standard equipment for precision crane work. These and dozens of other design features make the 51-B a worthy addition to the Bucyrus-Erie line, already world famous for dependable operation and tops for output. Your Bucyrus-Erie distributor has full details — see him today!

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New and Improved Construction Products

Locomotive Crane

A new 25-ton DiesELectric locomotive crane has been announced by American Hoist & Derrick Co., St. Paul, Minn. The new unit, designated as the American Model 825 DE, is manufactured under the company's patent for DiesELectric locomotive cranes. All deck operations are

Model 825 DE Locomotive Crane

accomplished by diesel power direct from the engine. Thousands of pounds of wearing parts have been eliminated resulting in sharply reduced maintenance costs.

A new 4-page brochure highlighting the new crane can be obtained from the company or by circling No. 38 on the prepaid postal card on page 100.

Further information can be obtained from the company.

Rotary Plow Flexibility Increased

A new loading and casting chute, announced by Wm. Bros Boiler & Mfg. Co., Minneapolis, Minn., for its rotary snow plows, increases their flexibility in highway, city street and airport work. The

Loading Chute Has 270° Swing

chute is revolving with a 270° swing from side to side, so that snow can be loaded into trucks on either side of the plow. Forward casting is often used in cleaning alleys or narrow lanes where space is not available for side casting or loading. When the chute is telescoped it serves as a snow caster, throwing snow in any position with the 270° arc. The chute is hydraulically finger-tip controlled within the cab. This new chute is available as standard or auxiliary equipment on Bros Sno-Flyr rotaries.

Further information can be obtained from the company or by circling No. 6 on the card at page 100.

Chain Saw Sharpener

A new medium priced, heavy duty handgrinder for sharpening contractor, logger and maintenance chain saws has been announced by The Dunmore Co., Racine, Wis. Equipped with a 1/10 HP motor, the sharpener runs on 115V, AC or DC . . . provides fast, low-cost sharpening for operators who have power at headquarters, or who have mobile equipment powered with a generator. File sharpening modern curved-teeth saws is impractical due to the tough, alloy steel now being used. Experience has shown

Handgrinder for Sharpening Chain Saws

power sharpening is not only 70% faster, but power-sharpened saws hold their edge 50% longer . . . a real improvement over the 2 to 3 hours between sharpenings with hand filing.

Further information can be obtained from the company or by circling No. 31 on the card at page 100.

Adjustable Discharge Moto-Mixer

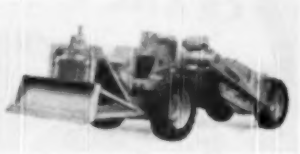
A new Rex adjustable discharge Moto-Mixer, announced by Chain Belt Co., Milwaukee, Wis., is a horizontal drum mixer with a high discharge feature. The new mixer corbines the fast, thorough mixing, fast charging, fast discharging and economical operation of the horizontal mixer with the versatility of the high discharge mixer. The discharge of the mixer can be elevated to a maximum height approximately equal to any high discharge type of mixer . . . or elevated to any intermediate point in the hoist range. This makes for greater flexibility in getting concrete into the forms with ease and speed, by reducing spout manipulation to a minimum. Other exclusive Rex features include Rex chain drum drive, Manten steel drum and blades, versatile spouting, enclosed water system and the Rex non-clogging water nozzle.

Rex Adjustable Discharge Moto-Mixer

Further information can be obtained from the company or by circling No. 3 on the card at page 100.

Tournapull Available With Dozen Blade

A bulldozer blade attached to its Model D Roadster Tournapull has been announced by R. G. LeTourneau, Inc., Peoria, Ill. The dozer blade is suspended in front of the Tournapull, cable-activated and is electrically-controlled by a switch mounted on the dash control panel. The blade has a bowl length of 6 ft. 8¾ in., height of blade and bowl is 32½ in. Its cutting edge is reversable,



Tournapull with Dozer Blade

with hard-surfaced, replaceable tips, and can be raised 3 ft. above the ground. Equipped with bulldozer the D Roadster Tournapull scraper can be used either as a dozer or scraper. Since all tools are on one rig, no time is consumed in changing from dozer to scraper operation, the manufacturer points out. It also can push load other D's in fleet operation, and can be roaded under its own power over the highway between scattered jobs.

Further information can be obtained from the company or by circling No. 4 on the card at page 100.

New Machine Maintains Road Shoulders

A new road machine announced by the Lull Mfg. Co., Minneapolis, Minn., is designed for the maintenance of road shoulders beyond the pavement and also is equipped with a unique patented automatic windrow eliminator. This is a one-

AND THE SERVICE MUST MEET LINK-BELT SPEEDER STANDARDS

ENGINEERING THAT IS SCIENTIFIC AND BASED ON EXPERIENCE

CONSTRUCTION THAT IS HONEST AND THOROUGH

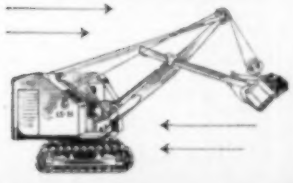
BACKED BY SERVICE THAT ASSURES FULL PERFORMANCE

Distributors' salesmen and service men constitute a vital force in carrying out the ideals and purposes of the Link-Belt Speeder Corporation, through their assistance to users in their respective territories. The training the distributors' servicemen receive at the Service Department School enables them to supply the most dependable and valuable service to their customers.

Be sure to see the

NEW LS-51

HALF-YARD
LINK-BELT SPEEDER
with Speed-o-Matic Hydraulic Controls



THE FINAL TARGET IS FOR MEASURING HALF-YARD SHOVEL-CRANE PERFORMANCE

Building a Link-Belt Speeder Shovel-Crane to the highest standards of design and construction is the beginning of our responsibility to the man who will operate it. During the useful life of that machine, Link-Belt Speeder Corp., here in Cedar Rapids, and the distributor who sells the machine are keenly interested in seeing that it continues to perform in tip-top shape. Tops in importance to the Service Department is keeping a stock of repair parts with every Link-Belt Speeder distributor for quicker and better field service.

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LINK-BELT SPEEDER

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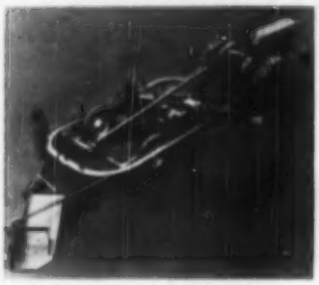
CEDAR RAPIDS, IOWA

Builders of the Most Complete Line of
SHOVELS-CRANES-DRAGLINES

pass machine. The front moldboard reaches to the outer edge of the shoulder and cuts, blades and rolls the material inward, toward the pavement, cutting



Lull Shoulder Maintainer Has Automatic Windrow Eliminator

high spots and filling all depressions and low spots, then the side and transfer moldboards, running parallel to the pavement slab, deliver the excess material to a rear spreading moldboard, which is positioned at an angle opposite to the front moldboard. The rear moldboard, equipped with automatic windrow eliminator, distributes the remaining material evenly and free of windrows.

Further information can be obtained from the company or by circling No. 36 on the card at page 100.

Portable Saw Cuts I-Beams

A newly-developed reciprocal gun type saw introduced by Transa, Inc., Minneapolis, Minn., will cut through any material from rubber to stainless steel. The stroke is adjustable up to a full 2 in. Special guides for various blade widths, from ⅛ in. to 1 in., eliminate whipping or snapping of the blades.

Transa Reciprocal Gun Type Saw

These guides are also used as "gun" sights in following a line. This tool is equipped with a handle which can be moved in any position to ease arm fatigue of the user when cutting at various angles. The unit will swivel 360° and lock in any cutting tangent. Concentration of power on the cutting stroke is made possible by ingenious gear arrangements.

Additional information is available from the company or can be obtained by circling No. 17 on the card at page 100.

Handlever Bed Turrets

An improved handlever bed turret is now being produced by the South Bend Lathe Works, South Bend, Ind., as an accessory for their 9 in., 10 in. and 13 in. swing lathes. This bed turret is so designed that by following simple instructions the user can accurately fit it to his lathe. Such an installation will make possible the economical production of precision parts, but will not change the basic lathe in any way. The turret can be removed and the tailstock quickly remounted for regular lathe work. The handlever bed turret mounts on the inside bed ways and the turret base can be locked in position at any point along the usable length of the lathe bed. The turret head can be positioned close to the spindle nose because the base is designed to clear the saddle wings. This eliminates excessive overhang of the turret tools. Double gibs provide precision adjustment for the turret slide and three needle bearings assure long life and easy action for the handlever assembly.

Further information can be obtained from the company or by circling No. 28 on the card at page 100.

New Sweeper Has Fluid Drive

A new tractor mounted fluid driven sweeper announced by Lull Manufacturing Co., Minneapolis, Minn., besides its usual street sweeping tasks can also

Lull Fluid Driven Sweeper

handle snow removal jobs. It is stated that it can remove snow pulls up to 24 in. and cuts snow over wide areas. The broom is completely adjustable from 32° right to 32° left, or straight across. Operation of the unit is stated to be smooth and free from shocks and jerks, due to the simple, direct, fluid power drive. Brooms of three different widths are interchangeable on the same sweeper frame.

Further information can be obtained from the manufacturer or by circling No. 14 on the card at page 100.

Off-Street Parking Meters

Newly developed parking meters, designed especially for off-street metered parking service, have been announced by The Dual Parking Meter Co., Canton, O. Although the new meters register coin-purchased time up to 12 hours per setting, they are in outward appearance virtually identical to the Dual 1-to-2-hour meters. Aside from almost identical appearance, practically all of the mechanical and component parts are likewise identical.

Further information can be obtained from the company or by circling No. 32 on the card at page 100.

Aluminum Brazing Wire

Air Reduction, 60 E. 42nd St., New York, N. Y., has announced that No. 718 aluminum brazing wire replaces No. 716. According to Airco, joints made with No. 718 wire are more resistant to corrosion, and parts required to withstand pressure show fewer leaks than with the wire formerly sold. The No. 718 aluminum brazing wire is sold in 3/32 in. and ⅛ in. diameters and is immediately available. The standard package for each coil is approximately 55 lb.

Additional information can be obtained from the company or by circling No. 19 on the card at page 100.

Heater Produces 100,000 BTUs Per Hour

A distilling type, oil-burning salamander brought out by Scheu Products Co., Ltd., Upland, Calif., produces 100,000 BTU's per hour on ¾ gal. consumption of fuel oil. The salamander can be used for inside or outside construction, for keeping freshly laid concrete from freezing when drying in winter months, for heating portable field offices, for drying plaster, etc. It burns any light fuel oil. Its patented return-gas stack design principle accounts for its excellent combustion and its soot-free characteristics. As it is a distilling type salamander it has no wick, valve, jets,

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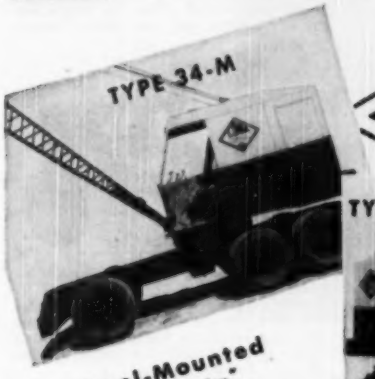
DEPENDABILITY and STAMINA plus the MOBILITY of Rubber Mounting



Wheel-Mounted
"Paymaster"

- Convertible Crane, Shovel, Dragline or Pull Shovel
- Powered by one engine
- One Operator Control—including travel
- Crane Capacity 20 tons (with outriggers)
- Shovel Capacity ¾ or 1 yard
- Travel Speed (maximum) 8.24 M.P.H.

3 TYPES

Truck-Mounted
"Paymaster"

- Convertible Crane, Shovel, Dragline or Pull Shovel
- Separate engine for travel
- Requires two operators
- Crane Capacity 20 tons (with outriggers)
- Shovel Capacity ¾ or 1 yard
- Travel Speed (maximum) 31 M.P.H.

Wheel-Mounted
Crane or Clamshell

- Powered by one engine
- One Operator Control, including travel
- Crane Capacity . . . 35 tons (with outriggers)
- Travel Speed (maximum) 5.27 M.P.H.

With these three rubber-mounted units you can now get all the other advantages of LIMA equipment—greater performance, less "down-time", longer life, etc.—*plus* the added benefits of greater mobility, less travel time, and better maneuverability. Rotating assemblies have the same basic features as corresponding crawler machines, with alterations adapting them to truck or wheel mounting. With outriggers supported, they provide extra capacity. They are ideal for operations requiring constant movement around the job, for small scattered jobs, or jobs remotely located.

THE LIMA LINE NOW INCLUDES:

Crawler-Mounted	*Rubber-Mounted*
Shovels, ¾ to 6 yds.	Shovels, ¾ and 1 yd.
Cranes, to 110 tons	Cranes, to 35 tons
Draglines, variable	Draglines, variable

It will pay you to consult your nearest LIMA Sales Office or Representative before you buy your next shovel, crane or dragline. Offices in principal cities of the World.

Lima Shovel and Crane Division

LIMA, OHIO

OTHER DIVISIONS: *Lima Locomotive Works Division; Niles Tool Works Co.; Hooven, Owens, Rentschler Co.*

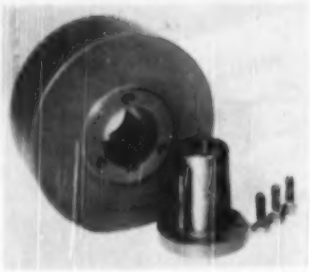
LIMA HAMILTON CORPORATION

or other parts which require replacement or service. It lights with a match. Burns from 10 to 20 hours. The burning rate is controlled by regulating the amount of air that is permitted to enter the heater's bowl.

Further information can be obtained from the company or by circling No. 27 on the card at page 100.

Clutch Coupling Has Taper Bushings

A new Rawson clutch coupling, announced by Centric Clutch Co., Cranford, N. J., is designed to accommodate any shaft from ⅝ in. to 1⅝ in. diameter (in 1/16 in. increments) with standard keys.



Rawson Clutch Coupling: Top, Motor Half; Bottom, Driven Half

The coupling is adjustable right on the job for various h.p. requirements. The coupling consists of two sections—a motor half and a driven half. Ready for use with motors from .43 h.p. at 580 r.p.m. to 25.7 h.p. at 1800 r.p.m. The manufacturer claims that this flexible Rawson coupling couples, cushions, limits the load and acts as a clutch; and that it can be used wherever a coupling is required to improve any motor drive.

Further information can be obtained from the manufacturer by circling No. 23 on the card at page 100.

Pulling Jack Has 20-Ton Capacity

A new Steamboat ratchet pulling jack of 20 tons capacity, introduced by Templeton, Kenly & Co., Chicago, Ill., for use in the construction engineering and marine fields, is designed to increase efficiency in both repair and maintenance jobs requiring heavy tonnage pulling. The new model is built with a 2 in. screw and is available in three barrel lengths of 24, 30 or 36 in. It is equipped with lock-link hook-ends for a secure, safe grip, with other operating features similar to those of other models in the complete Simplex line of Steamboat Ratchet Jacks.

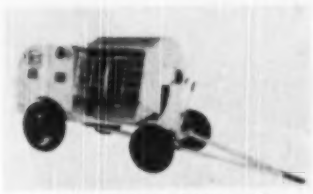
Usable to tie pilings and bents together, and for binding loads on trucks or flat cars and heavy duty pulling or hold-down jobs in construction, bridge and engineering fields.

Further information can be obtained from the manufacturer or by circling No. 22 on the card at page 100.

New Simplex Steamboat Ratchet

Mixer Keeps 50 Plasterers Busy

A new 10 cu. ft. plaster and mortar mixer, announced by Muller Machinery Co., Metuchen, N. J., is designed to supply from 40 to 50 plasterers with sufficient mixed material. The mixer is of the tip-over type having a mixing drum 36 in. diameter and 37 in. long. Heads and shell are of heavy tank steel and mixing blades give end to end action. Provided with a power tilt and specifically engineered for simple and easy



10 Cu. Ft. Plaster and Mortar Mixer

repairing in the field the mixer is driven by a Wisconsin air cooled engine rated at 18.7 hp at 2000 rpm.

Additional information can be obtained from the company or by circling No. 16 on the card at page 100.

Scraper Buckets

Sauerman Bros., Inc., 588 South Clinton St., Chicago, Ill., have announced that their "Lightweight" type Crescent scraper buckets in sizes from 2 to 5 cu. yd. now are manufactured in a new design, featuring a three-ply wearing section. This permits easy replacement of

New Design Crescent Scraper Bucket

the entire digging section in the field. Extra body reinforcement is provided by an outside belt channel.

Further information can be obtained from the company or by circling No. 40 on the card at page 100.

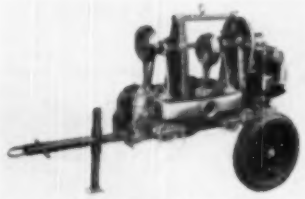
Bits Increase Drilling Speed

Crowned tungsten-carbide inserts to increase drilling speeds and self-cleaning chip channels are among the advanced design features claimed for Rok-Drill Bits by the manufacturer, Rock Bit Sales & Service Co., Philadelphia, Pa. They also point out that to overcome premature thread failure Rok-Bit threads are designed especially for each bit size and application. Better blowing is claimed to have been achieved by the placement of the air holes with a lowering of air consumption. The bits are of the detachable type and available in several sizes.

Further details can be obtained from the manufacturer or by circling No. 15 on the card at page 100.

Double Diaphragm Pump

A new double diaphragm pump has been announced by the Novo Engine Co., Lansing, Mich. Engineering, design, and construction of the new pump closely parallel that of the company's single diaphragm model. Like the single diaphragm pump, the new model handles



Novo Double Diaphragm Pump

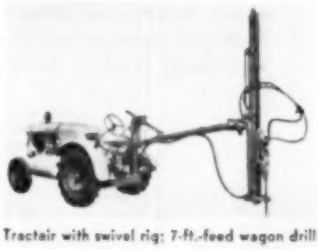
muddy, or sand and debris-laden water. However, since one diaphragm is always pumping while the other is discharging, there is a constant flow which doubles the new pump's capacity.

Complete specifications can be obtained from the manufacturer or by circling No. 8 on the postcard at page 100.

Boom Mounting for Drills

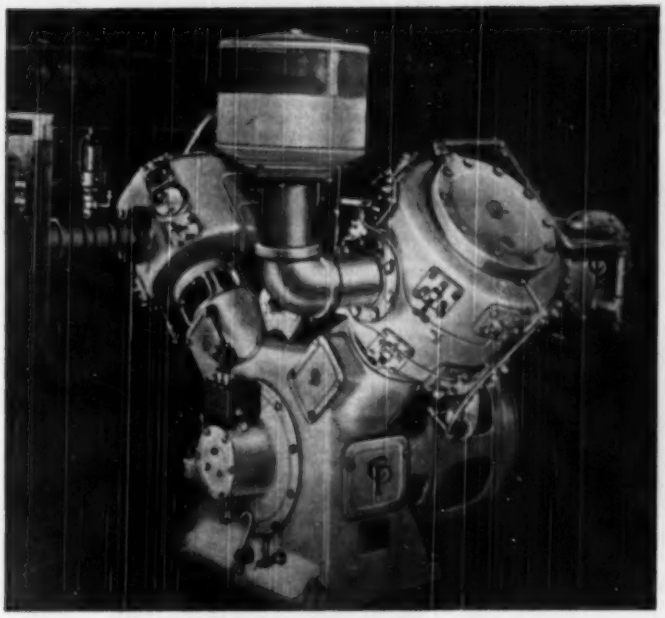
A special wagon drill designed to operate off the 105 "tractair", a combination 105-cfm. compressor and industrial tractor, has recently been announced by the Le Roi Company. By swinging the boom on which the wagon drill is mounted, six or more holes of a pattern may be drilled without moving the tractor-compressor unit. The boom works on a 6-ft. radius. The drill is ideally suited for operating in connection with a Le Roi Tractair mobile self-propelled compressor unit.

The drill is designed to handle ordinary drilling such as is usually done with a wagon drill, in road cuts, relocations, etc. This boom arrangement is also suitable for sewer work where rock drilling is necessary on a limited scale, and for light trenching for pipe lining. For further details, write the Le Roi Company, Milwaukee 14, Wisconsin.



Tractair with swivel rig; 7-ft.-feed wagon drill

For further information please circle No. 71 on inserted "Quick Help" card at page 100 and mail.



here's the answer to restricted floor space

—the Type Y Compressor

While its compact design makes it ideal for close quarter installation—it has plenty of other outstanding advantages.

It is shipped intact as a "package unit," ready for external connections.

It requires only a simple foundation and no special skill is needed to align and install it.

It operates at high efficiency because of such valuable features as large area Simplate valves, multi-step capacity regulation, effective inter-cooling, precision bearings and force-feed lubrication.

And finally it's extremely easy on maintenance.

Available with built-in or direct-coupled motor, or with V-belt drive, in capacities of 500 to 900 c.f.m., at 80 to 125 pounds pressure. Sizes for other pressures also furnished.

Write for full information.

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ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Form Clamps

A new all-steel wood form clamp announced by Pacific Engineering Sales Co., 215 W. Fifth St., Los Angeles, Calif., is designed to meet practically all curb, curb and gutter cross-sections in general use in all parts of the country, including advantages of the best in steel form design with the low cost of wood forms which require no changes to fit the clamps. The system is adjustable without requiring any other parts, for widths of top of curb from 4 in. to 8 in.

Application of Boult Form Clamps on Actual Job

Further information can be had from the company or by circling No. 12 on the card at page 100.

Three-Drum Hoist

An improved type of three-drum hoist, specially developed for operating the Sauerman Rapid-Shifting Drag Scraper Machines was introduced during 1949 by Sauerman Bros., Inc., 588 S. Clinton St., Chicago, Ill. The new hoists are designed for either gasoline, Diesel or electric drive and come in nine sizes for handling scraper buckets from ½ to 4 cu. yd. in capacity. In general features of design, these new hoists resemble the Sauerman standard roller-bearing scraper hoists. Drum shafts are stationary and are pinned to the side stands. Drum and gears are mounted on Timken roller bearings. The clutches are positively pushed into and pulled from engagement through these double tapered bearings, no springs being used. The intermediate shaft is supported in a double row of ball bearings in low side stands. Drive is through silent chain, totally enclosed in an oil tight guard case.

New Sauerman Three-Drum Drag Scraper

Further information can be obtained from the company or by circling No. 13 on the card at page 100.

Additional Uses for Dotmar Paver

The self-propelled curb and gutter paver of Dotmar Industries, Inc., Kalamazoo 1, Mich., is now being made so that it is adaptable to integral curb and gutter and sidewalk paving. The adaptation can be made by merely extending the machine to the desired width, using extensions on each side of the motor, which are provided. Screed and trowel designed for this type of work are then installed. Changing takes but a short time. Screed and trowel for any number of varying conditions can be furnished. The Dotmar paver can also be used to pave sidewalks alone, up to 60 in. in width.

Dotmar Paver on Denver, Colo., Job

The manufacturer will be glad to furnish further information or it can be obtained by circling No. 7 on the card at page 100.

Arc-Welder

The 200 amp. Hornet "Special" arc welder, the latest addition to their line of arc welding machines, has been announced by Air Reduction, 60 E. 42nd St., New York, N. Y. This machine combines the compact 36A generator with a four-cylinder, 31 h.p., air-cooled Wisconsin engine. The 36A generator, which has a welding range from 40 amperes at 20 volts to 250 amperes at 40 volts features the following: The 36A is built as a two-bearing unit. Closely spaced precision bearings provide maximum load safety. Double shields keep bearings dirt-free and hold grease in. The control wheel mounted on the panel shows accurate current markings—readily obtained by setting the pointer located in the center of the wheel.

Further information can be obtained from the company or by circling No. 35 on the card at page 100.

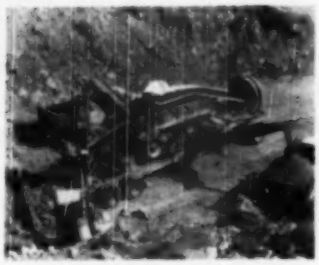
Rule Solves Flow Problems

A newly-designed plastic slide rule, distributed by C. J. Major, Wyandotte, Mich., solves problems in the flow of liquids in commercial pipes and smooth drawn tubing. The dimensional stability of the Vinylite rigid sheet plastic insures the accuracy needed in such an instrument. The rule solves the Fanning equation and may be used to calculate pressure drop, pipe diameter or rate of flow for any liquid whose viscosity and density are known.

Further information can be obtained from the manufacturer or by circling No. 18 on the card at page 100.

Double-Duty Crushing Plant

Recently developed by Iowa Manufacturing Co., Cedar Rapids, Ia., the new "Rock-It" crushing and screening plant is a double-duty plant that will replace two single units. Designed specifically for the aglime, chip and road stone fields, the "Rock-It" produces crushed stone or aglime, or a percentage of both, in one operation. Capacities range from 60 to 80 tons per hour. Simple design and compact construction make the "Rock-It" a highly portable plant. The only parts to remove to meet highway transportation requirements are the charging hopper and delivery conveyors. Other features include: Accurate gradation of the finished product, centralized controls, low feeding height for shovel feed, anti-friction construction throughout. Made up of standard Cedarapids units, the "Rock-It" plant consists of a 24 in. x 8 ft. apron type feeder and charging hopper with grizzly; a newly designed roller bearing jaw crusher with a full 18 in. x 24 in. jaw opening and jaws of standard thickness; a 42 in. x 10 ft. horizontal vibrating "aglime" screen; a Cedarapids hammermill, either 3033 or 2033; and a Cedarapids return wheel system of Monorail design. A 3018 roll may be used in place of the hammermill. A 2025 primary crusher may be used in place of the 1824.

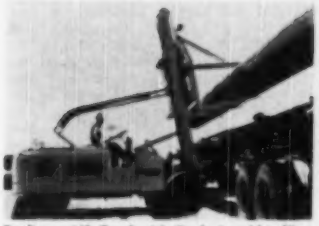


New Cedarapids "Rock-It" Plant

Bulletin RIP-1, containing complete details, dimensions and specifications, may be obtained from the company, or by circling No. 5 on the post card at page 100.

Grab Arm Developed for Lift Truck

A specially engineered hydraulic grab arm developed by the Gerlinger Carrier Co., Dallas, Ore., for its lift truck for use in laying of natural gas pipe line in California, should be of considerable interest to firms with material handling problems. The grab arm was designed to hold large and small circular material while traveling. There is a positive hydraulic pressure on both the forks and the upper grab arm, making it possible to securely grip the load travel. The grab arm can be raised and lowered by conveniently placed fingertip control. On the California job where the pipe was lying on the ground the forks dug in under as the grab arm came down to



Gerlinger Lift Truck with Grab Arm Handling 60 ft., 4-ton Pipe Section

lock the pipe for lifting. The use of chock blocks, cradles, etc., was eliminated.

Further information can be obtained from the company or by circling No. 25 on the card at page 100.

Markers Made of Plastic

A new traffic marker molded of tough Tenite plastic has been announced by Traffic Safety Supply Co., Portland, Ore. The disks, known as "Dur-O-Line", are

Dur-O-Line Traffic Marker

4½ in. in diameter, have a convex top and a flat bottom with waffle-type ribbing to provide maximum strength. They are furnished in either a chalk-white or a bright yellow color. They are applied to either asphalt or concrete surfaces by a special adhesive and a metal pin which is inserted through the countersunk hole in the top of the disk. It is claimed that a two-man crew can lay a hundred of the disks in an hour, and that no traffic holdups ensue. Traffic may run over the markers as soon as they are installed.

Further information can be obtained from the company or by circling No. 21 on the card at page 100.

Scoop Helps Soil Conservation

A tractor hauled earth scoop that can be used to do many earth moving jobs such as filling gullies or ditches, digging ponds or ditches, has been placed on the market by the Energy Farm Equipment Co., Monticello, Ia. All controls are handled from the tractor seat. A 2-speed hydraulic cylinder gives faster

Energy Earth Scoop

loading and quicker dumping. The special offset design gives maximum traction for the rear tractor wheels while loading because the deeper the cut the greater the downward pull on the rear tractor wheels.

Further information can be obtained from the company or by circling No. 29 on the card at page 100.

No Parking Standard

A new no parking standard has been announced by Industrial Products Co., 2820 N. Fourth St., Philadelphia 33, Pa. The unit is made with a 12 in. diameter, double faced, porcelain enameled sign plate mounted to a steel rod and supported by an 18 in. diameter cast iron base. Standard sign reads No Parking, white letters on a red background. Upright and base finished in black, weather resisting enamel. Height in service 45½ in. Weight 34 lb. Special wordings and color combinations may be furnished.

Further information can be obtained from the manufacturer or by circling No. 33 on the card at page 100.

Mobile Field Office

A mobile field construction office designed to eliminate the necessity for building temporary on-the-job offices has been developed by the Universal Trailer Corporation, Chicago, Ill. and Paramount, Calif. The trailer coach illustrated here contains ample deck room

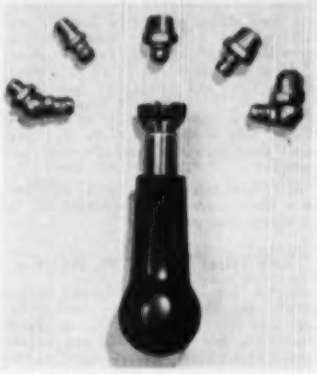
Mobile Field Construction Office

for three or four men, plus storage space in the rear, which easily can be converted into additional office room.

Additional information can be obtained from the company or by circling No. 26 on the card at page 100.

New Tool Speeds Grease Jobs

A new patented pocket-size tool designed to remove mud, ice, or any foreign matter from grease fittings has been introduced by Dover-Prairie Corporation, La Grange, Ill. The tool, which fits all standard grease fittings, is suitable for use in lubrication work on autos, tractors, trucks, busses, and road, farm, or industrial machinery, and any other equipment using standard grease fittings. Use of the tool is stated to prevent damaged gun tips and to eliminate damage to grease fittings caused by improper cleaning with screwdrivers or other unsuitable implements. Grease jobs are stated to be speeded because of the ease with which the tool cleans fittings to provide best connection with the grease gun. The new tool, called "Muskegg," consists of four special shape steel blades set in a spring-loaded shaft in a molded plastic ribbed handle.



Muskegg Grease Fittings Cleaner

Further information can be obtained from the company or by circling No. 20 on the card at page 100.

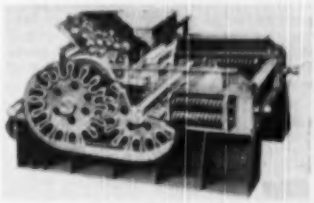
Federal Engine Improved

Two major improvements designed to increase power plant life and afford greater serviceability have been incorporated in the Series 60 engine of Federal Motor Truck Co., Detroit, Mich. To lengthen exhaust valve life, rotators have been added to the engine. Rotators turn the valves slowly during operation, insuring more even seating and cooler running New interchangeable precision copper lead alloy bearings with an electrically coated inside of lead and tin have replaced the bronze-backed cadmium nickel bearings. Design of the bearings is such that the complete assembly can be removed without disturbing the crankshaft.

Further information can be obtained from the company or by circling No. 39 on the card at page 100.

Roll Crushers

A number of improvements have been announced by Pioneer Engineering Works, Inc., Minneapolis 13, Minn., in its new line of twin and triple roll crushers. Improvements consist of deeper mounting sills with less obstruction from cross members to provide more clearance for conveyors, a deeper top frame, separately



Pioneer Crusher

cast star gears and driving gears and cast steel hubs for the roll shells, making the new line the strongest ever built. Twin roll crushers are now available in sizes 54 x 24, 40 x 22, 30 x 18 and 24 x 16. Two sizes of the triple roll are available: 40 x 22 and 30 x 18, the latter having just recently been added to the line.

Information is available from the company or can be obtained by circling No. 71 on the card at page 100.

Cap Reduces Blasting Vibration

A new line of fractional-second delay electric blasting caps announced by the Explosives Division of Olin Industries, Inc., East Alton, Ill., makes possible the reduction of vibration from blasting operations near populated areas. Instead of firing one large charge of explosives at one time and setting up one large shock wave, it is possible with the use of the new caps to break up a large charge into smaller portions and fire each portion at fractional-second intervals.

Additional information can be obtained from the company or by circling No. 34 on the card at page 100.

Lift Truck Has 62 Ft. Hoist

A new type lift truck, shipped to the government shale oil mine near Rifle, Colo., by the Wagnermobile Co., Portland, Ore., has a hoist that can be extended to a height of 62 ft. Built on the

Lift Truck With Hoist Extended to Height of 62 Ft.

well-known Wagnermobile tricycle chassis, the new piece of equipment was constructed to enable miners to work at heretofore inaccessible places at the Colorado mine. The hoist while nested is only 20 ft. in height. The scaffold as pictured here is approximately 3 x 12 ft. with adequate safeguard rail; however, it can be enlarged to accommodate any specified number of personnel. A safety feature of the scaffold is a remote control lever which enables workers to lower themselves as they work or in case of emergency.

Additional information can be obtained from the manufacturers or by circling No. 9 on the card at page 100.

Highway Mower

A new tractor highway mower brought out by Toro Manufacturing Co., Minneapolis 6, Minn., has a sickle bar driven by an independent motor. Other features of the new mower are: Low center of gravity, wide tread, short turning radius, full range of operating speeds up to 48 mph, four speed transmission plus reverse, quick hydraulic sickle bar lift, ample fuel capacity for 10 hours operation, comfortable bus type sent and a spring-mounted front axle. An automatic

New Toro Roadmaster

governor on the sickle bar keeps the reciprocating knife running at a constant cutting speed, independent of the tractor speed. Cutting speed can be regulated with a simple hand throttle. Without leaving his seat the operator can set the height of cut from 1½ in. to 10 in., for cutting over raised shoulders and curbs.

Further information can be obtained from the company by circling No. 70 on the card at page 100.

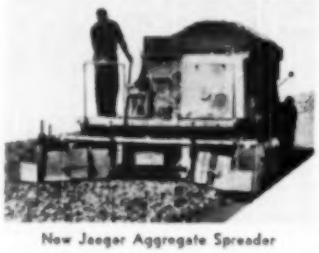
Rubber Pads for Crawlers

A process for vulcanizing resilient rubber to steel plates which when bolted to crawler pads permit movement of pavers over finished concrete without danger to the surface, has been announced by Metalweld, Inc., 26th and Hunting Ave., Philadelphia 29, Pa. Metalweld uses B. F. Goodrich Vulcalock bonding process in the rubber lining work, and rubber and steel are joined together with a bond strength of over 500 lbs. per sq. in., according to the firm. Metalweld points out that the use of these rubber pads eliminates the expense of labor necessary to continually relay belting and also enables the contractor to progress faster with paving operations.

Further information can be obtained from the company or by circling No. 37 on the card at page 100.

Self-Propelled Aggregate Spreader

A new self-propelled aggregate spreader stated to combine low cost, complete flexibility, and uniformly smooth and accurate finish of the laid material, has been placed on the market by The Jaeger Machine Co., Columbus 16, O.



New Jaeger Aggregate Spreader

The machine has many unusual design and mechanical features for accuracy, speed and flexibility of operation. Powerful four-wheel drive is always on the subgrade or rolled course, never on the newly laid material. The machine lays any size of aggregate up to 4-in. stone, in thicknesses up to 10 in., with positive accuracy. Its strikeoff screed is carried by long straightedge runners which glide smoothly on the subgrade despite any up and down motion of the wheels and machine itself. This new spreader is easily adjusted for laying materials in any width from 8 to 12½ ft. For widths from 10 to 12½ ft., hand-operated crank extends the transverse telescopic shaft between the straightedge runners and simple inserts increase screed width in increments of 6 in. For widths from 10 to 8 ft., block-off plates are provided. Automotive transmission and Continental gasoline engine offer 12 to 100 fpm forward speeds and ½ to 3½ m.p.h reverse speeds.

Bulletin SPS-9, is available from the company or can be obtained by circling No. 2 on the post card at page 100.

Grader Seat Aids Operator

A new seat designed to lessen operator fatigue and step up his efficiency is now standard equipment on all motor graders of the American Road Equipment Co., Omaha, Nebr. The hydraulic shock absorber, plus the soft cushion seat and back-rest, combine to cut down the shock of bumps and jolts over rough ground.

American Joy Rider Seat

A specially constructed sleeve permits a leveling-off action that keeps the operator level while the grader is at a slant. The seat is adjustable for height. This makes it possible for the operator to see the working blade and to have excellent visibility in all directions.

Additional information can be obtained from the manufacturer or by circling No. 24 on the card at page 100.

New Loader Has Adjustable Rear Section

A new self-propelled, self-feed, belt-type loader, the Adams TraveLoader, announced by J. D. Adams Manufacturing Co., Indianapolis, Ind., is designed to pick up and load into trucks any type of material which can be windrowed and which will pass up a conveyor belt. A revolving feeder, with 12 curved and beveled edge blades, moves the material up a metal pan and places it on the revolving conveyor belt. The feeder is hinged at the rear and is free to float so as to adapt itself readily to any size windrow. The gathering molds to the side of the feeder are adjustable to windrow width so as to keep the material flowing readily in a continuous stream through the feeder with the least possible friction and power loss. The rear section of the conveyor is adjustable so

as to provide a wide range of discharge heights. The claims for this wide adjustability are that by carrying the discharge height as low as possible to accommodate all trucks on the job the discharged load can be better distributed in the truck bed without spillage and dust is held to a minimum when dry material is being handled. The TraveLoader is powered by an International tractor-type gasoline engine, for operating the feeder and conveyor as well as propelling the machine.

Further information can be obtained from the company or by circling No. 1 on the card at page 100.

Mobile Bunk House

A mobile bunk house, which is finding use in the construction field, was shown at the first annual National Trailer Coach Industrial Exhibit, held recently in Washington, D.C. The bunk house has sleeping and sanitation facilities for 10 people.

Mobile Bunk House

The trailer illustrated here, a product of Pacemaker Trailer Co., Elkhart, Ind., has a double bathroom, clothes and food lockers for 10 persons.

Additional information can be obtained from the manufacturer or by circling No. 13 on card at page 100.

New Ford Truck Engine

A new more powerful 6-cylinder Ford truck engine with 4-speed synchro-silent transmission is now available as optional equipment on series F-6 Ford trucks of the Ford Motor Co. Designed to provide even greater performance and acceleration for heavy hauling and high speed on grades, the new Ford Rouge 254 Truck Six engine develops a maximum of 110 HP and 212 pound feet torque. It is the largest 6-cylinder engine produced for Ford trucks. The new engine embodies many outstanding performance, economy and durability features.

Further information can be obtained from the company or by circling No. 30 on the card at page 100.

New, Long-Wearing Shovel Teeth

Replaceable shovel teeth which lock rigidly to their adapters for longer wear are a new product of Baer Steel Products, Inc., at Auburn, Washington. Their patented triple-locking design distributes digging stresses over a larger locking

Shovel Teeth

area. Hence Baer teeth remain tighter and there is less adapter wear which permits the use of many more replaceable points. In addition the teeth are cast in a new, tough, shock-resistant steel to make them the most durable replaceable teeth on the market.

Tongues and slots, horn and shoe are wedged solidly together by a tapered pin driven through the assembly and securely locked by bending its malleable tip into a special recess.

For further data please circle No. 70 on inserted "Quick Help" card at page 100 and mail.

Rust Resistant Primers

A new multi-purpose, moisture proof, metal primer, known ah Lead-Chroxide, developed by Thomson-Porcelite Paint Co., Philadelphia, Pa., is claimed to be more rustproof than either red lead or Zinc Chromate when used by themselves. The new primer is a balanced blend of red lead, zinc chromate, and iron oxide in combination with a specially developed Thomson vehicle that brings out the best characteristics of each of the rust-inhibiting pigments. Led-chroxide has a tough, highly impermeable and rust-resistant film which provides an ideal foundation for finish coats. It dries tack free in 2 to 3 hours, overnight for finish coats, and covers approximately 500 to 600 sq. ft. per gallon, one coat, on smooth surface. Has complete hiding power in one coat; will not check, peel, or crack and can be applied by either brush or spray.

Further information can be obtained from the company or by circling No. 41 on the card at page 100.

MANUFACTURERS' LITERATURE

Construction Equipment Lubrication

A new lubricating equipment catalog announced by Lincoln Engineering Co., 5702-41 Natural Bridge Ave., St. Louis 20, Mo., shows how to keep construction machinery properly serviced at all times by providing on-the-job power lubrication. The catalog illustrates and describes compact, modern mobile lubrication departments to meet any requirement, and shows how to reduce lubrication time to a minimum and eliminate contamination and waste of lubricants.

Catalog can be obtained from the company or by circling No. 44 on the card at page 100.

Loader, Crane, Backhoe

The new Mandt loader is illustrated and described in a bulletin issued by the Mandt Manufacturing Co., 490 W. Goodale St., Columbus 8, O. This hydraulic powered loader handles from ¾ yd. standard material bucket up to 2 yd. snow bucket with 180° swing. Attachments provide quick conversion to mobile yard or factory crane operating 14 to 23 ft. booms, or to ¾ yd. backhoe excavator. Complete specifications are given.

Copy can be obtained from the company or by circling No. 65 on the card at page 100.

Electric-Eye Flame Cutting

A new bulletin published by Joseph T. Ryerson & Son., Inc., steel distributors, 2558 West 16th St., Chicago, Ill., illustrates intricate and unusual steel shapes supplied by this firm, cut to customer's order with their new electric-eye flame cutting equipment. Typical of some of the irregular shapes furnished are Diesel locomotive parts, sprockets, grinding wheels, boom bars, crank shafts, machine and equipment frames, and ornamental pieces. Shapes cut with the electric-eye machine are said to have sharper, squarer corners and greater accuracy than can be cut with other mechanized flame cutters, resulting in savings in fabricating costs and opening up new opportunities to use parts made of rolled steel.

Bulletin can be obtained from the company or by circling No. 62 on the card at page 100.

Otiscoloy Described

Otiscoloy, low alloy high strength steel widely used in the transportation industry is described in a 32-page brochure published by Jones & Laughlin Steel Corporation, Pittsburgh 30, Pa. Complete technical data including physical properties of Otiscoloy is enlivened with stories and excellent illustrations of fabricating operations and finished products. Industrial applications covered in the brochure include the manufacture of trailer trucks, buses and light trucks, tank semi-trailers, dump trucks and road machinery, power shovels and cranes, shipbuilding and dry-dock repair, mining equipment, building materials, and miscellaneous uses.

Brochure can be obtained from the company or by circling No. 61 on the card at page 100.

State Truck Laws Listed

The 1950 issue of the FWD "Truck & Trailer Sizes & Weight Restrictions" booklet now available from The Four-Wheel Drive Auto Co., Clintonville, Wis., lists all laws affecting the size and weight of trucks, trailers and truck-trailer combinations for every state and the District of Columbia.

This popular, pocket-size publication, originated by The Four-Wheel Drive Auto Co. in 1933, tells the truck operator what new laws will affect his truck and load upon crossing any state border. Permissible axle loads, length of trailers, overall lengths, number of trailing units, total gross loads and all other laws affecting truck operations are covered.

Copy of the booklet can be obtained from FWD or by circling No. 43 on the card at page 100.

Paved Corrugated Metal Pipe

A circular issued by United Steel Fabricators, Inc., Wooster, O., on its flexible paved corrugated metal pipe contains engineering data on the use of this product for highway drainage purposes. This pipe is made exclusively of ductible, heavy gauge US., copper steel or pure iron, heavily hot-dip galvanized and then coated partially or fully with a waterproof bituminous coating.

Circular can be obtained from the company or by circling No. 63 on the card at page 100.

Bituminous Pots and Buckets

Nineteen appliances each carefully designed for a particular type of tar or asphalt work are illustrated and described in a circular issued by Tarrant Manufacturing Co., Saratoga Springs, N.Y. The list includes crack fillers, pouring pots, emulsion spreader, sprinkler pot, etc., etc. The appliances are of light, strong, all welded construction.

Circular can be obtained from the company by circling No. 69 on the card at page 100.

Calcium Carbide

A 16-page booklet, "The Miracle of Calcium Chloride", published by National Carbide Corporation, 60 East 42nd St., New York 1, N. Y., traces the history of calcium carbide from the time of its discovery as a commercial possibility over 50 years ago, through the developments of manufacture and the current and potential usage of commercial calcium carbide, acetylene gas, and calcium hydrate residue. The booklet points out that calcium carbide gas—acetylene—was first prominent as an illuminating gas, then assumed prominence as a fuel gas for the welding and cutting of metals, and in recent years has become an important raw material used in the manufacture of plastics and synthetic rubbers. Potential uses of calcium carbide as an industrial chemical reagent and of by-product calcium hydrate as a source of high calcium line are described.

Booklet can be obtained from the company or by circling No. 57 on the card at page 100.

New Salt Product Prevents Rusting

A new salt product which will tend to prevent rusting of car fenders and underbodies when used to de-ice streets and highways has been announced by The Carey Salt Co., Hutchinson, Kan. Included in its manufacture is a rust-inhibiting chemical, "Banox," a product of Calgon, Inc., Pittsburgh, Pa., which forms a colorless, invisible yet protective film on metal surfaces when street slush is splashed against fenders and auto underbodies.

Further information can be obtained from the company or by circling No. 42 on the card at page 100.

Portable Electric Tools

A 74 page catalog issued by The Black & Decker Mfg. Co., Towson, Md., covers its complete line of portable electric tools. The line includes drills, hole saws, bench and portable grinders, saws, valve refacers, valve seat grinders, etc., etc. Over 78 products are illustrated and described.

Catalog can be obtained from this company or by circling No. 66 on the card at page 100.

Portable Light and Power Outlets

A 12-page bulletin on their String-a-Lite lines, issued by the Mines Equipment Division of Joy Manufacturing Co., describes, illustrates and prices latest designs of these popular assemblies of portable light and power outlets. To simplify installation and provide maximum portability, lines are sectionalized. Each section interconnected at proper intervals to form one continuous light or power string. When so connected assembly is dirt-proof, moisture-proof and oil-resistant. Manufacturer claims sections assemble simply, increase safety, reduce maintenance and can be used again and again under the most adverse operating or climatic conditions.

Copies of Bulletin SL202 are available from Dept. 28, Mines Equipment Division, Joy Manufacturing Co., Henry W. Oliver Bldg., Pittsburgh; or can be obtained by circling No. 56 on the card at page 100.

Four Velvetouch Catalogs Released

Four new catalogs, covering the complete Velvetouch line of all-metal clutch plates, facings and brake linings for Caterpillar, Allis-Chalmers, LeTourneau and International tractors and earth-moving equipment, have just been released by The S. K. Wellman Co., manu-

WHY MUNICIPALITIES BUY THE

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MULTI-FEATURE SNO-PLOWS

Over twenty years of snow removal experience in all types of snow conditions have made the Frink Sno-Plow superior for the rugged and continuous service necessary for cleaning the nation's highways, streets and airports.

Frink's fifteen Sno-Plows are scientifically built for faster, more economical snow removal.

Each one of these Frink plows is actually built to fit all snow conditions of some particular area.

The Frink Sno-Plows are built for trucks from a capacity of 1½ tons to 12 tons.

Write Box P31W, Clayton, New York, for further information.

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facturers of Velvetouch products. Each catalog covers all of the standard and replacement parts for an individual line of equipment, and is clearly indexed for easy reference. Listings include tractor model numbers, clutch and brake data, dimensions, drilling information. Velvetouch part numbers, and quantities required for replacement.

All catalogs available, no charge, upon request to the S. K. Wellman Co., 1374 E. 51st St., Cleveland 3, O., stating make of tractor and earthmoving equipment now in use; or circle the following numbers on the card at page 100: No. 52 for Caterpillar, No. 53 for Allis-Chalmers, No. 54 for LeTourneau and No. 55 for International Harvester.

7-in. Bench Shaper

A bulletin published by South Bend Lathe Works, South Bend, Ind., illustrates and describes their new 7-in. bench shaper. In addition to a complete description of the shaper, a 3-drawer steel stand, motors and tools are shown. Prices of all items are listed.

A copy of Bulletin No. 500 may be obtained from South Bend Lathe Works or by circling No. 60 on card at page 100.

Rotary Snow Plow

A new catalog illustrating and describing the Adams rotary snow plow has been announced by J. D. Adams Manufacturing Co., Indianapolis, Ind. The plow is designed for attachment to the front end of any current Adams heavy-duty motor grader. The plow cuts 9 ft. wide and a revolving rake which breaks up snow ahead of the plow may be raised to a height of 8 ft. to cut down deep drifts. The plow is independently driven by engines developing 180 h.p. The motor grader serves only to carry and propel the plow into the snow. An auxiliary transmission permits travel speeds as low as ½ m.p.h.

Catalog can be obtained from the company or by circling No. 49 on the card at page 100.

Care and Use of Transits

Instructions in the use and care of its transits are given in a booklet issued by Brunson Instrument Co., Kansas City, Mo. The booklet is written and illustrated from the point of view of the field man. Clarity and brevity are combined with technical drawings to make the guide easy to read, easy to understand. The style of presentation is helpful in the instruction of green operators.

Booklet can be obtained from the company or by circling No. 45 on the card at page 100.

Parsons Trenchmobile Described

Latest addition to the parsons line of Trenchliners, the utility-size, rubber-tire mounted Model 80 Trenchmobile, is described in detail in an 8-page catalog published by the Parsons Co., Newton, Ia. Parsons is a subsidiary of the Koehring Co. of Milwaukee. One-man operated, the Trenchmobile is designed for fast and profitable handling of small digging assignments formerly done by slow and costly hand methods. It travels anywhere under its own power at rapid speeds. Tractor-type pneumatic tires avoid damage to sidewalks, lawns and

STEP UP YOUR PAVING PROFITS!

JACKSON SIDE FORM VIBRATOR

Eliminates manual vibrating of concrete at side forms. Saves the better part of two men's labor. Mounts on any modern finisher, Jackson Vibratory Paving Tube or spreader. Employs two or more vibratory units that are simultaneously lowered into or raised from the concrete by the finisher operator. Units operate close to forms or reinforcement without fouling — ride over any obstruction encountered. Will not penetrate into sub-base. Assures thorough compaction regardless of speed of finisher or spreader — no spots missed. Long-wearing, trouble-free.*

JACKSON VIBRATORY PAVING TUBE

Quickly makes plastic the stiff, drier concrete mixes which effect up to 10% cement savings. Concrete at forms or joints is, under most conditions, puddled perfectly, thus saving manual vibrating. Reduces spreading cost, steps up finisher progress. Complete compaction, the full width of the slab, and excellent finish is obtained. Perfectly adaptable to slabs 6" to 24" thick and for regular single or two-course construction. Easily adjustable in the field from 10' to 25' slab-widths. Quickly attachable to any standard finisher. Ample power to offset fast drying and setting conditions.*

JACKSON PORTABLE POWER PLANTS generate both single phase and 3-phase 115 volt, 60 cycle AC. Ideal for lights and power tools. Capacities: 1.25 to 5 KVA.

OTHER JACKSON VIBRATORY EQUIPMENT — perfect for every type of concrete placement.

FOR SALE or RENT at your Jackson distributor.* Get your FREE copy of the Jackson "Pocket Guide" showing complete line.

MANUFACTURED BY ELECTRIC TAMPER & EQUIPMENT CO. FOR

JACKSON VIBRATORS, INC., Ludington, Mich.

curbs in work or travel. Sturdily built and powered by a 31 h.p. 4 cylinder gasoline engine the Trenchmobile is equipped to dig in eight separate feeds from 1.7 to 14.6 ft. per minute, 5 or 8 in. wide and up to 4 ft. deep.

Catalog can be obtained from the company or by circling No. 50 on the card at page 100.

Paver Catalog Discusses Production Capacity

A discussion of the relative production capacities of single drum and two compartment drum pavers is featured in the new catalog released by the Koehring Co., 3026 West Concordia Ave., Milwaukee, Wis. The remainder of the bulletin is devoted to a complete description of the improved Koehring unit, the 34-E Twinbatch Paver. More than 45 photographs and illustrations graphically describe the high capacity production features developed in the 34-E Twinbatch. Time-tested engineering details are discussed in detail, such as, Koehring's exclusive design crawler shoes and three-point unit suspension mounting that increases operating stability, the 34-E's big, flowline skip for fast drum charging and the accurate syphon-type water measuring system.

Catalog can be obtained from the company or by circling No. 67 on the card at page 100.

Adjustable Forms for Bridge Railings

A specially-designed steel form that answers the problems arising from grade and vertical curve conditions on concrete rail bridge jobs is featured in a folder of Concrete Forms Corporation, Irvington, N. Y. The panels on this form have adjustable inserts which are easily angled to varying grade conditions. Allowance is made for insertion of fillers, so that the panels may be set to any required grade. The folders gives details of the forms and an assembly drawing of form panels.

Folder can be obtained from the company, or by circling No. 48 on the card at page 100.

100 Welding Alloys Described

Latest metal-joining information on Eutectic "Low Temperature Welding Alloys" is available in the Directory Welder for 1950, issued by Eutectic Welding Alloys Corporation, New York, N. Y. Featuring 65 outstanding EutecRods for torch welding and EutecTrodes for arc welding, this issue is profusely illustrated with case histories that will be a source of interest to welding engineers and technicians. Among the products listed in this preview of advance 1950 information is the announcement of the new line for stainless steel arc welding. A complete selection chart is also included for information on the numerous specialized welding alloys of Eutectic for particular jobs.

This publication can be obtained from the company or by circling No. 47 on the card at page 100.

Tool and High Speed Steels

A 16-page booklet, "The Working of Tool and High Speed Steels," issued by Allegheny Ludlum Steel Corporation, Henry W. Oliver Bldg., Pittsburgh 22, Pa., contains technical data certified by the metallurgical staff of the corporation. Called a "Blue Sheet", the booklet gives specific information summarized from carefully checked laboratory and

Quick Help on Product Information

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- ☐ 1 Bins and Hoppers
- ☐ 2 Conveyors
- ☐ 3 Crushers
- ☐ 4 Portable Plants
- ☐ 5 Screens

II BITUMINOUS:
- ☐ 6 Batchers
- ☐ 7 Finishers
- ☐ 8 Distributors
- ☐ 9 Dryers
- ☐ 10 Heaters
- ☐ 11 Plants (central)
- ☐ 12 Plants (travel)

III CONCRETE:
- ☐ 13 Batchers
- ☐ 14 Buggies and Carts
- ☐ 15 Finishers
- ☐ 16 Joints, Exp. and Contr.
- ☐ 17 Mixers (under 1 yd.)
- ☐ 18 Mixers (1 yd. up)
- ☐ 19 Pavers
- ☐ 20 Reinforcing Steel
- ☐ 21 Road Forms (1000' set)
- ☐ 22 Tower
- ☐ 23 Truck Mixers

IV CRANES:
- ☐ 24 Crawler Mounted
- ☐ 25 Truck Mounted
- ☐ 26 Piledrivers

V GRADERS:
- ☐ 27 Blade self propelled
- ☐ 28 Blade, pull type
- ☐ 29 Blade, under truck
- ☐ 30 Elevating

VI LOADERS AND TRENCHERS:
- ☐ 31 Front-end loader (tractor mounted)
- ☐ 32 Loader, bucket type and belt type
- ☐ 33 Trencher or Ditcher

VII HAULING EQUIPMENT:
- ☐ 34 Dump Truck
- ☐ 35 Other Trucks
- ☐ 36 Dump Wagons, tractor drawn
- ☐ 37 Flatbed Trailers

VIII PUMPS:
- ☐ 38 Centrifugal
- ☐ 39 Diaphragm
- ☐ 40 Piston

IX POWER UNIT: (Independent)
- ☐ 41 Gasoline
- ☐ 42 Diesel
- ☐ 43 Electric

X ROLLERS:
- ☐ 44 Power (Smooth)
- ☐ 45 Pneumatic Tire
- ☐ 46 Sheepsfoot

XI TRACTORS:
- ☐ 47 Crawler
- ☐ 48 Rubber Tired

XII TRACTOR EQUIPMENT:
- ☐ 49 Bulldozers
- ☐ 50 Power Control Units
- ☐ 51 Rippers
- ☐ 52 Scrapers, tractor drawn
- ☐ 53 Scrapers, self-powered

XIII BUCKETS:
- ☐ 54 Clamshell
- ☐ 55 Concrete
- ☐ 56 Dragline
- ☐ 57 Orange Peel

XIV SHOVELS AND DRAGLINE:
- ☐ 58 Crawler (under 1 yd.)
- ☐ 59 Crawler (1 yd. up)
- ☐ 60 Truck Mounted

XV ROCK DRILLS, AIR TOOLS:
- ☐ 61 Air Compressors
- ☐ 62 Backfill Tampers
- ☐ 63 Clay Diggers
- ☐ 64 Concrete Vibrators
- ☐ 65 Drills, cable tool
- ☐ 66 Drills, tripod and wagon
- ☐ 67 Drills, rock, hand-held
- ☐ 68 Paint Sprayers
- ☐ 69 Paving Breakers
- ☐ 70 Riveters and Chippers

XVI MISCELLANEOUS:
- ☐ 71 Buildings, portable
- ☐ 72 Earth Drills, power
- ☐ 73 Light Plants
- ☐ 74 Lubrication, Service
- ☐ 75 Mowers, Highway
- ☐ 76 Power Saws
- ☐ 77 Soil Stabilizing Equipment
- ☐ 78 Spreaders, sand
- ☐ 79 Street Flushers
- ☐ 80 Street Sweepers
- ☐ 81 Welders
- ☐ 82 Cutting Torches
- ☐ 83 Hydraulic Jacks
- ☐ 84 Hydraulic Control Equipment
- ☐ 85 Hand Tools
- ☐ 86 Hoists, derrick type
- ☐ 87 Highway Guard
- ☐ 88 Snowplows, rotary
- ☐ 89 Snowplows, v or wing
- ☐ 228 Salt

Use This Coupon

Other products not named above, or specific variety of the products checked .....

Your name ..... Title or Profession .....

Name of your company or governmental dept. .....

Type of work for which equipment will be used .....

Street Address .....

City ..... State ..... County .....

QUICK HELP FOR YOU TODAY!

Let Roads and Streets help you efficiently, economically, quickly.

Save your time, your secretary's time, stationery and postage by letting us handle your information needs.

FIRST, fill in your name, title, company or government department, street address, city and state at the top of the card.

•

THEN—

A If you want information about any of the products advertised in this issue of Roads and Streets, enter the advertisements' page numbers and advertisers' names in section A of the card.

•

B If you want more facts about any of the new equipment or the trade literature described in this issue, circle the proper numbers in section B of the card.

•

C If you want catalogs for any of the products listed on the opposite page, enter the proper product names or numbers in section C of the card.

IT'S as simple as ABC—fast, dependable, and without obligation on your part.

Readers' Service Dept.

ROADS AND STREETS
22 West Maple Street
Chicago 10, Illinois

My Name _____ My Title _____
My Firm or Govt. Dept. _____
St. Add. _____ City _____ State _____

RUSH PLEASE SEND ME AT ONCE

Information about the products advertised on:

A Page ____ by ____ Page ____ by ____
Page ____ by ____ Page ____ by ____
Page ____ by ____ Page ____ by ____

More new equipment information or trade literature on items circled:

B

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75

Catalogs describing the following products listed on opposite page:

C _____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____

1-60 RS

My Name _____ My Title _____
My Firm or Govt. Dept. _____
St. Add. _____ City _____ State _____

RUSH PLEASE SEND ME AT ONCE

Information about the products advertised on:

A Page ____ by ____ Page ____ by ____
Page ____ by ____ Page ____ by ____
Page ____ by ____ Page ____ by ____

More new equipment information or trade literature on items circled:

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1-60 RS

My Name _____ My Title _____
My Firm or Govt. Dept. _____
St. Add. _____ City _____ State _____

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61	62	63	64	65	66	67	68	69	70	71	72	73	74	75

Catalogs describing the following products listed on opposite page:

C _____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____

1-60 RS

A NEW LEAF FOR YOU TO TURN OVER!

Right Now!

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 82, Sec. 510, P. L. & R., Chicago, Ill.

ROADS AND STREETS

22 WEST MAPLE STREET

CHICAGO 10, ILLINOIS

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 82, Sec. 510, P. L. & R., Chicago, Ill.

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ROADS AND STREETS

22 WEST MAPLE STREET

CHICAGO 10, ILLINOIS

On the reverse side of this sheet is an opportunity for you to get **quickly, efficiently and economically** all the information you may need about:

A Products advertised in this issue of Roads and Streets,

B New equipment described in it or new trade literature mentioned, or

C Any other products—machinery, equipment, materials or supplies—that may interest you. A suggestive list—specially compiled and arranged for your convenience—appears on the next preceding left-hand page. Consult it.

The Readers' Service Department of Roads and Streets is ready to help you now or at any other time, and as frequently as your needs may require. Do not hesitate to make full use of it; you will not be obligated in any way.

So, turn this leaf now and let us start helping you today.

Readers' Service Dept.
ROADS AND STREETS
22 West Maple Street
Chicago 10, Illinois

service tests on various grades in the A-L line. The booklet begins with a simple selector chart and then tersely gives procedures and tabulations that form a working manual for makers and users of cutting tools and dies. Typical heads are: design, machining, cutting-tool angles, speeds, heat treatment, grinding.

Booklet can be obtained from the company or by circling No. 58 on the card at page 100.

Bronze and Copper Bearings

A new 28-page catalog, "Bronze and Copper Bearings and Castings" released by National Bearing Division of American Brake Shoe Co., New York, N. Y., gives physical properties and comparative specifications for 27 different bronze alloys and 5 aluminum and manganese bronzes. It contains an outline of the many applications of bronze. Sizes and weights of rough and machines "Tiger" Bronze bars are tabulated. Babbitt metals, their descriptions and uses, are also discussed and illustrated, and their various physical properties are charted.

Catalog can be obtained from the company or by circling No. 46 on the card at page 100.

Crushing and Screening Plant

A brochure, issued by the Crusher Division, Nordberg Manufacturing Co., Milwaukee 7, Wis., contains many drawings with suggestions for arranging equipment to make up complete portable and semi-portable crushing and screening plants. This brochure, "Symons Cone Crushers and Symons Vibrating Screens in Portable and Semi-Portable Plants", contains flow-sheets and tables showing arrangements, horsepower requirements and conveyor, screen and crusher specifications for various hourly production capacities.

Brochure can be obtained from the company or by circling No. 59 on the card at page 100.

Valuable Surveying Instrument Catalog

Engineers and contracting organizations wishing the latest information on surveying instruments, will be interested in the new catalog of W. & L. E. Gurley. Entitled "Gurley Engineering Instruments", Condensed Catalog No. 80, this 96-page publication describes the features and specifications of its transits, levels, attachments, and such important elements and parts as telescopes, stadia arcs, tripods, etc.

For a copy of this catalog address W. & L. E. Gurley, Troy, N. Y., giving full name, organization or title, and address; or check No. 51 on card at page 100.

Air Entraining Agent

A formulation totally unlike any other air entraining agent on the market is described in a brochure issued by A. C. Horn Co., Inc., Long Island City, N.Y. This product, Ayr-Trap, is a synergic mix consisting of two elements, each of which is present in such minute quantity that it causes no undesirable effect. Yet, in combination these two components in such small quantities give the full measure of air entrainment. Included in the brochure is an example of concrete design, with and without the use of Ayr-Trap. Tables also are given on its use in concrete mixtures.

Brochure can be obtained from the company or by circling No. 68 on the card at page 100.

Concrete Vibrators

A new line of high speed Universal concrete vibrators is described in a folder issued by the Master Vibrator Co., Dayton, O. Included in the folder are illustrations and descriptions of the Master portable gas-electric generator plant for the concrete vibrators and portable tools; the Universal models electric motors; and the Universal models, gasoline engine powered.

Folder can be obtained from the company or by circling No. 64 on the card at page 100.

(Continued from page 86)

cheaper where they are found close to the job site and where transportation facilities are available. Manufactured aggregates can be satisfactorily used, where economy dictates their use, by adjustments in the mix proportions.

A greater cement factor is required to produce a workable concrete when using manufactured aggregates than is necessary to produce concrete of equal workability from natural aggregates.

The use of an air-entraining agent is a definite asset in producing concrete made from manufactured aggregates to give suitable workability and satisfactory durability.

ICE *Control ...* by BURCH

THE "TILT-LEV" BLADE

For not only ice and slush removal but for a year-round, general purpose blade, the Burch "Tilt-lev" is unexcelled. Greater clearance, positive hydraulic control—fits any standard truck.

SANDERS — CHIP-IT-OVERS — SNOW PLOWS

Write for name of nearest Burch distributor

THE BURCH CORPORATION — CRESTLINE, OHIO

SINCE 1875

WITH THE MANUFACTURERS & DISTRIBUTORS

Hall Made Sales Director

Fred C. Hall

Fred C. Hall has been appointed director of sales for the American Coach & Body Co., Cleveland, O., manufacturers of utility truck bodies. He succeeds Clarence G. Wood. Mr. Hall has been a member of the American organization since 1936. He has concentrated on sales work and has represented the company in the western half of the United States. In 1946, he was chosen to open the company's new California division at Oakland. As general manager, he has been the active executive officer of the division, until his recent recall to Cleveland as director of sales for the entire company.

Whitney Chain Moves

Whitney Chain & Manufacturing Co., Division of Whitney Hanson Industries, Inc., has moved to new and larger headquarters at 3317-25 W. Newport Ave., Chicago 18, Ill.

Heads Mack Distributor Sales

A. G. Crockett

Albert G. Crockett has been appointed manager of distributor sales for Mack-International Motor Truck Corporation, Empire State Bldg., New York City. He will head up Mack's entire domestic and Canadian wholesale organization of some 500 distributors. Director of Mack's market research department since the war, Mr. Crockett joined the company in 1927 as a member of the sales promotion department and was acting manager of that activity in 1943 when he began a three-year period of service as an officer in the Office of the Assistant Secretary of the Navy.

Graybill Promoted by General Tire

Richard Graybill, heretofore manager of the New York branch of General Tire & Rubber Co., Akron, O., has been promoted to manager of the Philadelphia branch. Roy F. Brown has been appointed to succeed Graybill as manager of the company's New York branch. R. F. Blundin, former Philadelphia branch manager, has resigned. In assuming managerial reins in the Philadelphia branch, Graybill directs General Tire sales for Pennsylvania, Delaware, Maryland. District of Columbia and the northern parts of Virginia and West Virginia. Brown's appointment gives him direction of New York, New Jersey, and Conpecticut.

New Galion Distributors

The following new distributors have been appointed by Galion Iron Works & Mfg. Co., Galion, O., for their motor graders and rollers in Mississippi and Idaho: Road Materials & Equipment Co., Inc., Jackson, Miss., covers all counties in Mississippi with the exception of those north of the counties of Bolivar, Sunflower, Leflore, Carroll, Montgomery, Webster, Clay, and Lowndes. Western Equipment Co., 4009 Fairview Ave., Boise, Idaho, covers all counties in Idaho south of the county of Idaho; also the Oregon counties of Wallowa, Baker, Union, and Malheur, and the county of Teton in Wyoming.

Persons Heads Division

Robert W. Persons has been appointed product sales manager of the newly-created Drill Steel Division of Crucible Steel Co. of America, 405 Lexington Ave., New York, N. Y. Mr. Persons has been associated with Crucible since 1930 and has specialized in sales and application services for drill steels and allied products.

James Lauder Is Dead

James Lauder, long connected with The Macleod Co., Cincinnati, O., died suddenly Dec. 5, of a heart attack. He was at work all that day and left his office in the same happy spirit as always. Several hours later he was taken ill and died almost immediately.

You Can't Beat Welded Construction
WELLMAN
Williams Type BUCKETS
• Wellman pioneered welded rolled steel construction for longer life and greater service. It's the extra strength that gives the extra, low-cost digging power. Whatever your requirements . . . whether for Multiple Rope, Power Arm, Dragline, Power Wheel or Special Service—specify Wellman!
⅜ to 16½ yd. capacity.
SEND FOR BULLETIN
THE WELLMAN ENGINEERING COMPANY
7003 CENTRAL AVENUE • CLEVELAND 4, OHIO

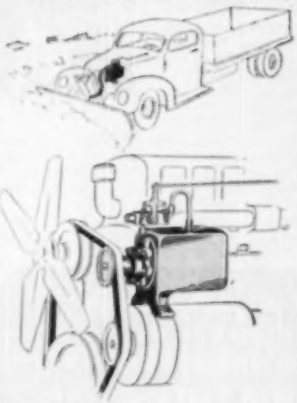
Pruneau Promoted by Worthington

Howard H. Pruneau has been promoted to construction equipment regional supervisor for the Midwest territory of Worthington Pump and Machinery Corporation, Harrison, N. J. His headquarters will be in Chicago. Mr. Pruneau was formerly a sales engineer at Missoula, Mont. He succeeds H. J. Schultz who resigned.

Joseph W. Hennen Resigns

Joseph W. Hennen has resigned as manager of the Findlay Division of Gar-Wood Industries, Inc., a position he has held since July, 1946. He expects to engage in the manufacture of construction machinery and will announce his plans soon.

POWER HYDRAULICS for Snow Plows



- Thousands in use.
- Fit all trucks.
- Fan belt or electrically driven models.

Write Hydraulic Division

MONARCH ROAD MACH. CO.
325 North Front Ave.
GRAND RAPIDS 4, MICHIGAN

VULCAN PAVEMENT AND CLAY DIGGING TOOLS

ARE MADE in a complete line of sizes to fit all standard compressed air hammers.

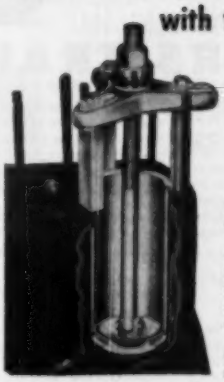
Send for NEW Vulcan Illustrated CATALOG today.

TOOLS — THE WORLD OVER — NOTED FOR QUALITY AND DURABILITY

VULCAN TOOL MFG. CO
QUINCY, ILLS.

Pull Wet or DRY SLEEVES EASILY, QUICKLY, SAFELY —

with the **OTC** NEW NO. 970 UNIVERSAL CYLINDER SLEEVE PULLER



STEADY PULL WITHOUT FRICTION assured by the long, fine threaded screw and the heavy thrust bearing.

ADJUSTABLE to provide clearance regardless of the position of cylinder studs — simplifies centering of tool over the bore. 39 adaptor plates handle over 200 makes and models of trucks and tractors. They can be applied from the top.

APPROVED by *Allis-Chalmers, Caterpillar, Case, International, Oliver, Massey Harris and others.*

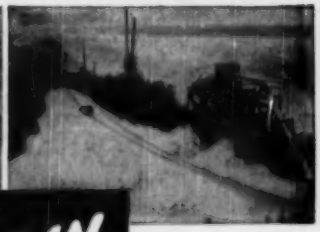
When You Need PULLERS — Order OTC from Your Jobber

OWATONNA TOOL CO.
319 CEDAR STREET — OWATONNA, MINN.

AUTHORIZED DISTRIBUTOR OTC MAINTENANCE TOOLS

OTC NO. P-61 REVERSIBLE RATCHET
recommended for use with No. 970 — speeds up operation 50% — especially on dry sleeves. Has many uses

FOR ALL DIG-AND-HAUL WORK!



Sauerman Cableway pictured above is digging gravel from bar in river and hauling to top of screening plant in one operation. Handles 700 cu. yd. a day at cost of few cents a yard.

CUT TIME IN HALF with Sauerman

This picture shows a small Sauerman Scraper handling large stockpile of silica at processing plant. Scraper stocks out material from washery and reclaims at regular intervals from stockpile to dryer.

Long Range Scrapers and Cableways

Sauerman Crescent Scraper Bucket

Digging, hauling and dumping operations are combined in one continuous process making possible big savings in both time and labor. Only one man is required for complete control of the operation. Sauerman Cableway and Scraper Machines provide wide range of handling capacities and long reach. Remarkably low operating and maintenance costs. Gasoline, electric or Diesel. Write for interesting new catalog and describe your digging and handling problems.

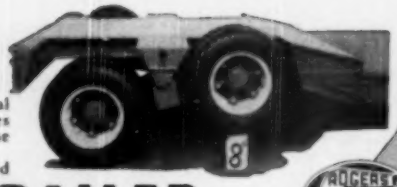
SAUERMAN BROS., Inc. 588 S. Clinton St., Chicago 7, Illinois

A ROCKING BEAM Trailer?

YES HERE IT IS!

Rogers also builds trailers for unusual needs, embodying characteristic features of fundamental design but modified to meet the special requirements.

For example, consider the above illustrated



ROGERS TRAILER

• This is the new Model T trailer which has two rocking, box-girder sections at each end of which is a spindle, carrying a wheel and two extra large tires. This design gives the desired oscillation and permits building trailers only 8 feet wide in capacities up to 35 tons. This two axle trailer meets the needs existing in some states that limit the tonnage that can be carried on one axle.

Write for information on standard or special trailers which have been tested in difficult service.

ROGERS BROS. CORP.
110 ORCHARD ST. ALBION, PA.
Export Office: 50 Church St., New York 7, New York
Cable Address: "Brosciles"

EXPERIENCE . . . builds 'em
PERFORMANCE . . . sells 'em

Julius P. Heil Is Dead

Julius P. Heil

Julius P. Heil, founder and chairman of the board of The Heil Co., Milwaukee, Wis., died suddenly Nov. 30 of a heart attack. Mr. Heil grew up on a farm, matured as a machinist, and pioneered in the welding process. As a young man he traveled widely throughout the world installing a newly-patented process of welding street car rails. In 1899 he installed the first electric railway in Buenos Aires. In 1901 he founded his own company with savings of $550 and three employees. Early products included welded truck bodies, storage and transport tanks. He weathered the first ten difficult years by working from 12 to 16 hours a day for a salary of $2 per day. Always a believer in diversification, Mr. Heil began the manufacture of oil-fired home heating units and water systems in 1924. In 1930 the company produced the first mobile farm forage crop dehydrators and started building bottle washes in 1934. By 1936 Heil was manufacturing bulldozers and scrapers for the construction industry. In addition to the above the Heil line of construction equipment now includes contractors truck bodies, rock truck bodies, conversion hoists and Heiliner wagons.

New Warco Distributor

Construction Equipment Sales, Inc., 2264 University Ave., St. Paul, Minn., has been appointed distributor for the Warco Motor Graders of W. A. Riddell Corp., in the state of Minnesota.

Thornburg Joins Marlow Pumps

R. Thornburg

Ralph Thornburg has been appointed district sales representative for Marlow Pumps, Ridgewood, N. J. Mr. Thornburg was associated with the Yale and Towne Manufacturing Co., Pump Division, for 11 years—the last 7 years as sales manager. He resigned from this position to take charge of sales of the Marlow line of construction pumps on the East Coast, from Metropolitan New York to Virginia.

"I BOUGHT 'ANTHONY' DUMP BODIES— —THEY COST ME LESS"

Contractors everywhere are buying where they can do the best. As one contractor recently remarked:

"After weighing all of today's factors of price, quality and performance I bought Anthony Dump Bodies and Hoists . . . they cost me less."

For prices on equipment to meet your specifications it will pay you to call your Anthony distributor. Quick delivery from stock. Write for name of your Distributor.

ANTHONY HYDRAULIC

ANTHONY CO., Streator, Illinois

it's a pleasure . . .
TO STAY AT THE HOTEL RALEIGH . . . WHEN IN WASHINGTON, D.C.

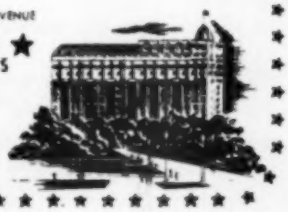
See history in the making. The Pentagon Building, the new Jefferson Monument, the Mellon Art Gallery, and many other points of historic interest. Hotel Raleigh offers elegant comfort, excellent cuisine. 400 air-conditioned rooms, reasonable rates. In the heart of official Washington. . . . Drive into our hotel garage.

HOTEL Raleigh

MIDWAY BETWEEN THE WHITE HOUSE AND THE CAPITOL
ON FAMOUS PENNSYLVANIA AVENUE

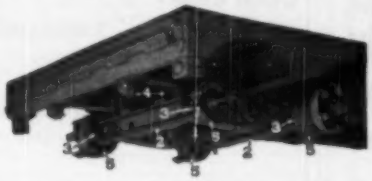
SPECIAL COURTESIES TO HONEYMOONERS

Write for booklet or honeymoon brochure to C. C. SCHIFFELER VICE PRESIDENT AND MANAGING DIRECTOR Or your own travel agent



BE SURE YOUR NEXT TRAILER HAS ALL THESE FEATURES:

Deep, wide flange main beams running the full length of the trailer, I-Beam sections for cross-members and outriggers, improved, fabricated gooseneck, and *all* electric-welded construction. Look at all the other features found only on Jahn tandem axles: (1) constant lift cam, (2) two full-width axles attached to longitudinal rocker beams, (3) worm gear type slack adjusters at each wheel, (4) heavy coil springs at each axle and (5) positive equalizing braking at each wheel regardless of position of axle.

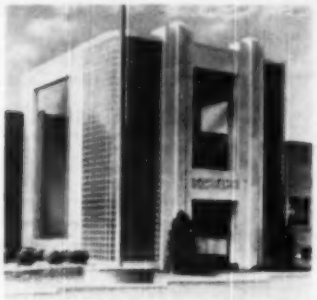


JAHN TRAILERS — ALL OVER THE WORLD

C. R. JAHN COMPANY
Dept. 45
212 Main St. Savanna, Ill.
Heavy duty trailers from 5 to 100 tons.

Schramm Celebrates Golden Anniversary

Schramm, Inc., West Chester, Pa., manufacturers of air compressors, celebrate their 50th anniversary this year. Starting with a modest little machine shop in Philadelphia, Pa., Jan. 2, 1900, Schramm compressors are now built in a large, modern factory covering an area of 17 acres. Chris D. Schramm, the founder, originally dedicated his business to servicing and selling gas engines. In 1901, Henry N. Schramm, now president,



Main Entrance to Schramm Inc. Plant

joined his father at a time when electric ignition was being developed for gas engines. Together they developed a make-and-break spark ignition head that quickly established them as gas engine experts, along the Atlantic Seaboard from Maine to Florida. The next important development was the first complete portable engine driven compressor in 1908, featuring an interchangeability of parts that has become one of the outstanding features in the development of all Schramm compressors throughout the many years of this firm's existence. From this modest beginning, the business soon grew to proportions that made it necessary to acquire larger factory facilities and in 1917, the business became established in West Chester, Penn.

This Portable Asphalt Plant is Suitable for All Paving Maintenance

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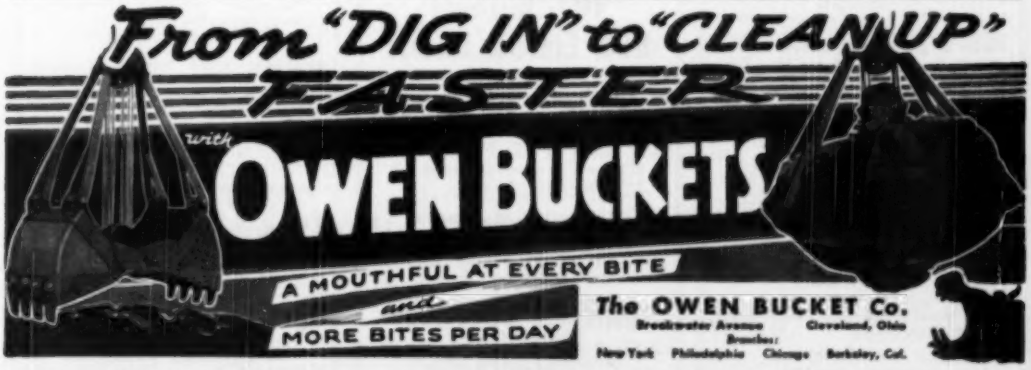

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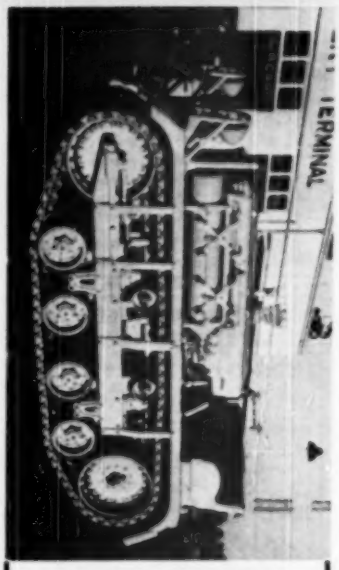

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Portable Air Compressors, 315 CFM Ingersoll Rand Air Cooled. Hundred lbs. Powered by Waukesha Diesel.
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Unit 514 backhoe with dragline and 30-ft. boom. Good condition, looks and works like a new machine. Priced right.

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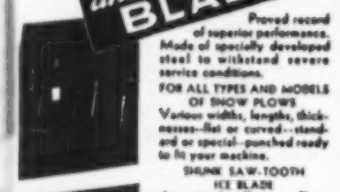

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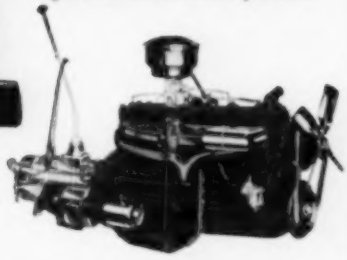

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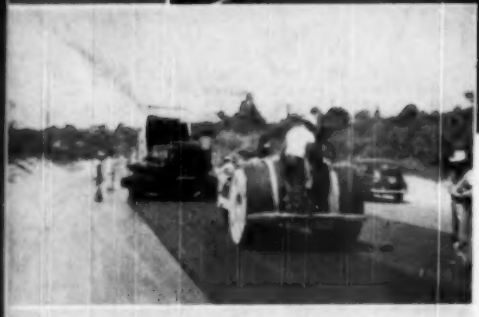

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